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NOTS ltr 25 May 1967

FC

HANDBOOK FOR AUTHORS OF TECHNICAL REPORTS

FIRST EDITION

This publication has been reviewed in accordance with OPNAVINST 5510.17. The security classification shown is correct for the full document. When separate, the abstract is...UNCLASSIFIED the title is.....UNCLASSIFIED..

29 June 54
(Date)

Technical Publishing Division
U.S. Naval Ordnance Test Station

NOTS 440
SEPTEMBER 1951

U.S. NAVAL ORDNANCE TEST STATION

HANDBOOK FOR AUTHORS OF TECHNICAL REPORTS

Edited by

C. E. Van Hagan

Technical Publishing Division

NOTS 440

U. S. NAVAL ORDNANCE TEST STATION, INYOKERN

China Lake, California

September 1951

First edition, fourth impression

FOREWORD

In a large organization with widely diversified interests, such as the U. S. Naval Ordnance Test Station, Inyokern, a few broad guidelines to the preparation of technical material for publishing are essential if the publications are to have the effectiveness that derives from continuity of presentation.

In their present form, the guidelines presented in this handbook are a preliminary treatment of the problem. The Technical Publishing Division welcomes comments and suggestions made with a view to increasing the value of the book as a useful tool in the prosecution of the Station's reporting program.

This handbook is not intended to be a complete treatise on the writing of technical reports. There are many reference books which, as a group, fill this need. The goal in preparing this handbook is to provide a "desk top" work book, covering only those areas that experience with NOTS manuscripts has shown to be particularly troublesome and at the same time amenable to standardization.

Acknowledgment is made of the substantial contributions and assistance provided by all members of the Editorial Branch and others in the Technical Publishing Division, especially the editor of this handbook, C. E. Van Hagan. Particular mention is also due the following: Vance Gudmundsen, D. T. McAllister, Jeri N. Walsh, and Marian R. Weiser. It is also appropriate to acknowledge with gratitude the contributions of editors in other departments, whose suggestions and comments have become a part of Technical Publishing Division practice.

A. E. TYLER
Head, Technical Publishing Division

CONTENTS

INTRODUCTION

At the Naval Ordnance Test Station, as at all other research laboratories, the publication of technical reports is an important feature of the over-all program, for the discovery or development of a new theory, process, or weapon is of little value unless the information is passed on to those who can put it to practical use. With an ever-increasing flow of reports, it is apparent that careful consideration must be given to their preparation if the Station's reputation as the outstanding research, development, and test organization in the field of naval ordnance is to be upheld. Similarly, the reputation of the individual scientist or engineer depends, at least in part, upon the reports that bear his name.

This handbook has been prepared for the convenience of the authors of NOTS reports and the many people who cooperate with them in bringing these reports to the point where they are ready to be submitted to the Technical Publishing Division (TPD) for publication.

The handbook has been arranged in four parts: How To Write a Report, Manuscript Preparation, Transmission of Manuscripts, and Matters of Style.

Comments and suggestions that may be of value to the author who is actually engaged in writing a report are offered in Part 1, with the aim of easing him through this final and frequently difficult stage of a project.

Preparation of the physical manuscript is dealt with in Part 2, where matters of format and the handling of the pages are discussed in detail. This part includes information on the preparation of references and bibliographies, tables, and illustrations. Minimum requirements for the transmittal of a manuscript from your department to the Technical Publishing Division are presented in Part 3.

Finally, Part 4 sets forth basic style as followed at NOTS in the publication of reports. Here may be found discussions on capitalization, abbreviation, the use of numerals, signs and symbols, and the principles of compounding.

Part 1
HOW TO WRITE A REPORT

GETTING IT DOWN ON PAPER

In general, the authors of technical reports may be divided into two types: the logical "planner" type of investigator, and the scientific worker with the intuitive approach. Both have their place in research and development endeavors, and both contribute greatly to the advance of science. Because of their natural work habits, however, their report-writing techniques are usually different.

If you are the logical type of worker, you will have planned the course of your investigation well in advance, devoting much thought to the selection of the proper methods of reaching your research goal. You will, either consciously or unconsciously, have planned much of your report while you planned the investigation.

Regardless of your method of writing a report, however, you may find it wise to write preliminary drafts of various sections of the report during the course of your investigation. For example, complicated test setups can be described better while they are actually before your eyes; discussions of many processes can be written more accurately at the time of the tests; and when test results are perishable, it is wise to get a description of them down on paper as soon as possible. Moreover, writing preliminary drafts of isolated sections of a report will help you to decide whether the photographs taken at various stages of the work are adequate or whether more or better photographs should be taken.

If you are the intuitive type of investigator, you will find it difficult, if not impossible, to proceed in the manner described for the logical investigator. For you the easiest approach may be to start writing without any previous thought about the structure of your report. As ideas occur to you, you will dash off a paragraph or two between appointments in your office or laboratory, or at other odd moments during the course of the work. If you follow this technique of fragmentary writing, the important thing to keep in mind is that you must discuss only one topic in a paragraph. The various report bits that you compose as you go about your work should be accumulated in a file. When you are ready to prepare your report, spread the contents of your file on your desk and sort the various paragraphs into a logical grouping, arranging the items in each group in orderly sequence.

To insure a complete and logical presentation and to avoid undesirable repetition, you will find it helpful to set down the organizational structure of your report. The suggested skeleton outlines presented in Fig. 1-4 will be very helpful in giving you a generalized pattern in which to arrange the material you have written. As you develop your report, you will find that it is necessary to write additional connective paragraphs linking the basic material into an integrated whole. In writing these paragraphs, keep in mind the need of the reader for "signposts" to point out for him the direction your thought is taking as you move from one section of the report to the next.

Whatever your approach to the writing of a report, always keep in mind the answers to these three questions: What am I trying to say? Whom am I writing the report for? Does this particular word, phrase, or sentence contribute to an understanding of the subject?

THE AUTHOR'S ATTITUDE

Occasionally expressed, but more frequently submerged in the subconscious, is the attitude of some authors that "this wasn't easy for me so why should I make it easy for the reader?" And there is the unfortunate situation in which an author, understandably proud of his learning and accomplishments in his field, may let this very natural pride carry over into a show of self-conscious erudition in his writing. This latter circumstance is the more regrettable because it is completely unnecessary; subjected to the test of time and practical application, the author's work will stand or fall on its merits without regard to the "learned style" or complex verbiage he may choose in writing technical literature.

Because the various sciences are today so interdependent, and because each scientific worker must rely on the work of others for the advancement of his own studies, the technical writer is responsible for making his contribution to the literature in his field in a form which is as clear, as readily grasped, and as quickly assimilated as possible.

Your job, as the author of a report, is to present your information clearly and accurately, with no particular thought to the enhancement of your own position in the field. That will follow as a natural result of good work carefully reported. Experience has shown that the success of a scientific or technical man depends 75 percent upon his ability to express himself and 25 percent upon his technical ability. You will best discharge your obligation to communicate the re-

sults of your work to others if you will be as precise and as intellectually honest in your statements as you can, and if you approach the problem with a recognition of your responsibility to contribute to the general body of scientific knowledge in the same way that you draw from it in support of your own work.

USE OF THE REPORT OUTLINE

The thinking of those who are concerned with technical reporting is divided on the value of using a basic outline as a tool for establishing proper report structure and insuring complete presentation of technical material. Some authorities feel that many reports suffer from the author's attempt to fit the information into a rigid and preconceived outline form. Others believe that the most serious common fault in technical reporting is an illogical presentation of material and that the proper use of basic outlines may help the author avoid this pitfall.

Experience has shown, however, that the most satisfactory method for the majority of writers is to set down a fairly complete outline before they begin to write. The details of such an outline will usually depend upon the skill and experience of the writer. If you are an old hand and writing "comes easy" to you, a simple skeleton outline that establishes the primary sections of your report will be enough; but if you are new at the business, with an uncertain hand, it will be to your advantage to outline each step of your report with great care.

To illustrate the technique of outlining, several typical outlines are presented in Fig. 1-4. They cover the general subjects of Research, Development of Ordnance, Evaluation or Comparison of Ordnance, and Cataloging. These outlines are presented as examples only, and should not be considered fixed or unchangeable. The outline for a specific report will always depend upon the material to be covered, the quantity of material, and the purpose of the report. Never try to force your material into some preconceived form.

The purpose of an outline is to insure continuity, a logical presentation, and completeness. Intelligently used, the samples in Fig. 1-4 can be of considerable help in clarifying numerous difficult reporting situations. Many of the pitfalls inherent in the use of ready-made outlines may be avoided if it is recognized that they offer only a general pattern. They are best used as a check list by which you can determine whether or not you have included all the information needed for presenting your subject properly.

INTRODUCTION

Historical Background. Give a brief résumé (the shorter the better, usually less than 250 words) of previous or related work to orient the reader and provide him with a point of view from which to evaluate the work you are now reporting.

Statement of Problem. Tell what information you are seeking and what you are trying to prove. Give condensed statement of assignment, if applicable.

METHODS

Instrumentation. Describe instrumentation necessary to your investigation or research.

Research or Investigative Techniques. Tell how you went about the work of seeking answers to the questions set forth in "Statement of Problem" above.

RESULTS

Data Reduction Techniques. Tell how you processed the raw data which will be presented in "reduced" form in the following section. Write a separate paragraph for each technique. Be brief!

Description and Interpretation of Results. Tell what you found out (verbally and graphically) and explain what you believe to be the significance of your discoveries.

CONCLUSIONS. Relate your results to the historical theory and, if the results warrant, formulate a new theory or an extension of the old. Call attention to possible practical applications. State to what degree your results provide answers to the questions posed in "Statement of Problem" above.

APPENDIXES. Place in appendixes any material which is not an integral part of the work reported, but which might be of real help to a co-worker in the field, such as the derivations of equations or discussions of related subjects.

REFERENCES

FIG. 1. Suggested Outline of a Research Report

INTRODUCTION

Historical Background. State the need for the particular item of ordnance; describe briefly previous work or ordnance of which present development is an outgrowth, and give condensed statement of BuOrd task assignment, if applicable.

Statement of Problem. List in detail the desired characteristics of the device. Give the design considerations based on list of characteristics (usually not required in interim reports).

DESCRIPTION OF ORDNANCE DEVELOPED

Physical Characteristics

Functional Characteristics

FIG. 2. Suggested Outline of a Report on Development of Ordnance

TESTS

Performance Trials
- Instrumentation
- Methods
- Results

Operational Trials
- Methods
- Results

CONCLUSIONS. Make an appropriate point-by-point comparison of the physical specifications, performance, or operation of the ordnance item with the goals established by the task assignment, the statement of the problem, or the requirements of the service forces.

RECOMMENDATIONS. Give suggestions for modification of ordnance, for revision of specifications, or for additional or auxiliary equipment or techniques, as applicable.

APPENDIXES. Include mathematical derivations or theoretical considerations pertinent to the development reported.

REFERENCES

INTRODUCTION

Statement of Problem. Define and establish standards for the evaluation (comparison) to be made. Include condensed statement of BuOrd task assignment, if applicable.

Description of the Ordnance Under Examination. In some reports this description may be included under "Evaluation (Comparison) of the Ordnance," below, in direct juxtaposition to the results obtained. This is particularly true in the case of comparison of two or more entities in which both the description (verbal or pictorial) and the results (verbal or pictorial) can be presented very briefly.

Instrumentation Necessary to the Evaluation or Comparison

Methods of Evaluation or Comparison

EVALUATION (COMPARISON) OF THE ORDNANCE. Give a point-by-point discussion of the results of the evaluation in answer to the questions posed in "Statement of Problem."

CONCLUSIONS. State the extent to which the tests have proved that the ordnance under examination meets the standards set forth in "Statement of Problem"; or show how the items compare with each other.

RECOMMENDATIONS. When appropriate, suggest how the ordnance can be made to meet the specifications; or include a well-formulated proposal for additional examination if warranted.

APPENDIXES. Include mathematical derivations or theoretical considerations pertinent to the evaluation reported.

REFERENCES

FIG. 3. Suggested Outline of a Report on Evaluation or Comparison of Ordnance

INTRODUCTION. State the need of the Navy for, or the purpose of, the facilities, or for the catalog itself. Indicate possible uses for the catalog, and describe how it is organized.

CLASSIFICATION GROUPING WITH APPROPRIATE HEADINGS. The organization of this material should be on a functional rather than a structural basis as far as possible. In a catalog of facilities, for example, the reader is usually interested only secondarily in the buildings in which the facilities are housed; he is primarily concerned with what the facilities can do and what use he can make of them. Consequently, the material should be organized on the basis of the functions of which the facilities are capable, and the heading of each section should indicate the functional purpose of the facilities described under that heading.

CONCLUSIONS. Summarize the uses to which the facilities can be put, or what the literature survey indicates.

APPENDIXES. In the facilities report, an appendix is the ideal place in which to give a brief review of the programs (completed, in progress, or planned) in which the facilities have been, are being, or will be used. In general, appendixes include any material not directly necessary to the exposition of the main theme of the report, but which might be helpful to the serious worker in the field.

REFERENCES

NOTE: Reports falling into this classification are usually of the type known as "facilities reports," but may also deal with cataloging of literature or experience (e.g., *Record of Experience in Locating and Recovering Missiles at Morris Dam Torpedo Range*).

FIG. 4. Suggested Outline of Catalog Type of Report

THE EDITOR'S FUNCTION

Before your report is ready for publication, it must pass through the hands of an editor. His function is to assist you in presenting your material in language that is not subject to misinterpretation, to counsel you on matters of style and format, and to serve in some measure as the reader's representative in helping you make an adequate and lucid presentation of your subject matter.

As your primary job is to carry out the research, testing, or developmental work of the Station, so the editor's main concern is to prepare the reports on this work for publication. From experience gained in handling a great many reports of all kinds, he makes suggestions as to the most effective way of wording your statements, organizing your material, and designing your tables, graphs, and illustrations. In the interests of the Station, he must, of course, make certain that the language you use is grammatically correct and that your style is in keeping with the publication policy of the Station. In addition, he "marks up your copy" in a way that will be understood by the compositors and artists who prepare your report for printing.

As the author, it is essential that you review your manuscript after it has been edited and before it is sent to composition. During this review, you have an opportunity to discuss with the editor any of the changes he has made. If you feel that your thought has been changed, you will usually find upon closer inspection that the original statement was worded so as to permit several interpretations. Statistical studies of manuscripts in which this occurs show that, in the vast majority of cases, the editor selects the proper interpretation of the several which could have been made from the ambiguous statement. In those instances where you feel that the editor has selected the wrong interpretation, he will be glad to rework the material with you until it conveys the meaning you intend. You will always be given an opportunity to reach an agreement with the editor when there is a difference of opinion on the meaning of a sentence or phrase, for he has no ax to grind and is interested only in producing a report that cannot be misunderstood.

The editor also acts as your agent during publication; he sees that, as far as possible, your wishes are carried out by the artists, compositors, and layout people, and he checks carefully at each processing stage to eliminate errors. His work is finished only when the bound proof of your report has been finally checked and approved.

SECURITY

It is a basic tenet of Navy classification procedure that the originator of any development or piece of work establishes the security classification. This authority carries with it a great deal of responsibility for protecting the interests of the United States while at the same time making scientific and technical information as widely available as possible. Written material should not be classified more highly than the facts warrant because this limits its distribution; on the other hand, arbitrarily classifying material below its proper status not only can cause acute embarrassment to the originator and the Station but also may actually endanger the interests of the United States.

Certain formalities must be observed in connection with the publishing of classified material. The author is referred to the *U. S. Navy Security Manual for Classified Matter* for a complete discussion of the subject, but the following points are worthy of note.

Report Numbers. A published report is a document separate from the manuscript from which it is prepared. Consequently, a published report does not carry the same document number as the manuscript. The publisher's statement in the report will refer to the document number of the manuscript from which the report was prepared. The report number assigned by the Technical Publishing Division (together with the copy number) forms the document number of a published report.

Pagination. Classified reports must have all pages numbered consecutively. There may, however, be two consecutive series of numbers in a single report, as follows: the "preliminary matter" will be numbered in lower-case Roman numerals, and the "body" of the report, beginning with the first page of the text, will be numbered in Arabic numerals. The publisher's statement on the inside front cover must show the total number of leaves in the entire book.

Page Identification. Each page of a classified report must carry a running head to identify that page with the book. The running head may be the title of the book, an easily recognized short title of the book, or a serial number (for example, "NAVORD Report 0000"). Each page must also carry the classification at both the top and the bottom.

Reference to Documents of Higher Classification. In a classified report, reference may be made to documents of higher classification if the reference is made by means of file numbers, document numbers, etc., that do not in themselves convey any information of a classification higher than the report in

which the reference is made. The title or subtitle of the referenced document may also be given if it does not convey information of a classification higher than that of the document in which the reference appears. This same provision may be extended to the referencing of classified material in an unclassified report provided, of course, that the references themselves convey only unclassified information. This will usually limit such references in unclassified documents to file numbers or document numbers and put a drastic limitation on the use of titles.

COPYRIGHT AND COURTESY

Whenever you wish to include material that has been published by someone else, you must first determine whether it is protected by copyright. This you can do by looking for the required copyright notice, which is normally located on the back of the title page, but may occasionally be found on the title page itself or on the front cover. In periodicals the copyright may appear on one of the covers, the contents page, the first editorial page, or the first page of each article. Remember that an entire compilation, such as a given issue of a periodical, may be covered by one copyright.

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Before making use of copyrighted material in a report, you must obtain permission from the copyright owner. Written permission, or a photostatic copy of it, must be forwarded to the TPD with your manuscript.

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plan to quote extensively from a publication that is not protected by copyright, you should obtain written permission from the author in advance, even though this is not required by law. This courtesy applies not only to text that you wish to quote but also to illustrations, tabular matter, or graphic material.

Part 2
MANUSCRIPT PREPARATION

GENERAL COMMENTS

Part 2 of this handbook is concerned with certain details in the actual preparation of a "final draft" manuscript for transmittal to the Technical Publishing Division. The conversion of your manuscript into a published report will proceed more rapidly and with less work (for both you and the Technical Publishing Division) as the suggestions presented in the following sections are followed.

The procedures of drafting, reviewing, and approving a manuscript are not covered, because these are established separately by each department to meet its own requirements.

The manuscript and accompanying material as delivered to TPD should usually comprise the following:

Title Page	Separate Copy for Tables
Foreword	Illustrations (Photographs
Abstract	in Duplicate)
Table of Contents	Copy for Figure Legends
Body of Report	Copy for Footnotes
Reference Matter	Authorization To Publish

You may also find it desirable to include an acknowledgment, a list of nomenclature, or one or more appendixes.

The author is urged to retain a complete duplicate copy in his file for reference in answering queries and as a safeguard against loss or mutilation of the original.

In the following pages the individual parts of the report are discussed in detail with suggestions both to the authors, who are the originators of the copy, and to the typists who have the task of preparing the final manuscript to be submitted to TPD for publication.

TITLE PAGE

To the Author. The title itself should be as brief as possible without sacrificing meaning. The title must be descriptive of the material covered in the report, but is not written in sentence style and should be phrased so as to require a minimum of punctuation. Avoid the use of articles (*a*, *an*, *the*) as much as possible, and do not start a title with *On the . . .*

A report published as two or more separate parts under the same report number must have a suitable general title, but each part may also carry a distinctive subtitle. A revision of a report previously published carries the identical title of the original report, followed by the revision identification (e.g., First Revision), and is published under the same report number as the original. A supplement, which is published under the same title and report number as the original, includes the supplement number and may include a distinctive subtitle.

To the Typist. The title page must carry the classification at both the top and the bottom, and, in common with all MS. pages, it should carry your department MS. number in the upper right corner. The name of the Station and the names and titles of the Commander and the Technical Director are placed a little below the top classification. The title is typed in all caps and located as shown in Fig. 5. Titles of two or more lines are typed in an inverted pyramid. Subtitles are typed below the main title in caps and lowercase letters. If there are two authors, type their names on separate lines with the word *and* between them. Names of more than two authors are typed with the name of each on a separate line, but the word *and* is not used at all (see Fig. 5). The name of the cognizant department is located below the name(s) of the author(s) and is underscored. The locations of the report numbers are indicated, but the numbers are supplied later by TPD. Do not use an underscore in lieu of the actual numbers. *China Lake, California,* is typed at the bottom of the page. No date of publication is shown on the manuscript copy; it is supplied later by the editor, who will use the date of transmission of the MS. from your department to TPD as the publication date.

00/MS-000

C L A S S I F I C A T I O N

U. S. NAVAL ORDNANCE TEST STATION, INYOKERN
Capt. W. V. R. Vieweg, USN — Commander
Frederick W. Brown, Ph.D. — Technical Director

THE TITLE OF THE REPORT SHOULD BE LOCATED HERE, ALL CAPS

By

John H. Jones

Wilbur R. Smith

Jane Roe

Cognizant Department

FIG. 5. Sample MS. Title Page

NAVORD REPORT

NOTS

China Lake, California

C L A S S I F I C A T I O N

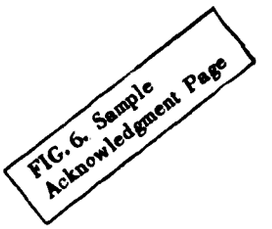
ACKNOWLEDGMENT

To the Author. An acknowledgment is not required, but you may briefly acknowledge the work of others in a separate preliminary section. It is here that you may give credit to the colleagues who have given you material assistance in the prosecution of your project. You may acknowledge the help of individuals; of branches, divisions, or departments; or of outside companies or organizations. It is not customary to make special mention of the men whose assistance lay in the normal performance of their jobs. Refrain from elaborate or flowery statements of your indebtedness to those who have assisted you. A simple mention of a man's name and the nature of his service retains the desired dignity of the formal technical report. Verify the spelling of all names included in the acknowledgment.

To the Typist. In NOTS reports, the acknowledgment is typed on a separate page (see Fig. 6), which is located immediately after the title page. The word ACKNOWLEDGMENT is typed in all caps and centered. The remainder of the page should be typed double- or triple-spaced in regular paragraph style. The classification should be typed or stamped at the top and bottom of the page, and the MS. number should be placed in the upper right corner. The acknowledgment is paginated in Roman numerals as part of the preliminary matter.

ACKNOWLEDGMENT

The authors are indebted to J. A. Jones of the Materials Evaluation Group, Design and Production Department, for assistance in the development of processing techniques. Special acknowledgment is also due to K. R. Smith of the California Institute of Technology for his contribution to the derivation of the formulas used in the evaluation section of this report.



FOREWORD

To the Author. In a NOTS report the foreword is printed over the name of the department head who has authorized its publication; therefore, it must be written from his point of view. It should identify the pertinent task assignment (this should be carefully verified before the report is transmitted to TPD) or project, date the work, relate the report to other reports or phases of a general investigation, and establish the level of authority.

The foreword is the place to discuss objectively such matters as completeness, usefulness, limitation, and the degree of finality of the work reported. If an outstanding piece of work has been done by the author, it is in order for the department head to give him due credit in the foreword.

It is required that the names of the men who have reviewed the report from the technical standpoint and can vouch for the technical accuracy of its content be listed in the foreword, customarily in the last paragraph.

To the Typist. Every Class 2 report must include a foreword. It is started on a separate page and located after the acknowledgment, if there is one; otherwise, immediately after the title page. The classification is typed or stamped at the top and bottom of the page, and the MS. number is placed in the upper right corner. The word FOREWORD is typed in all caps and centered. The remainder of the page is typed double- or triple-spaced in regular paragraph style. The foreword is paginated in Roman numerals as part of the preliminary matter.

At the end of the foreword, type the name of the department head in all caps near the right margin, and under it type and underscore his title and the name of the department. Two lines below this and located flush left, type *Released by:* followed by the name of the Technical Director, as shown on Fig. 7. Be sure to verify the spelling of the names of the technical reviewers and their initials. Do not use titles with civilian reviewers (for example, omit Dr., Mr., Miss) but give the rank of military personnel (for example, use Capt., Cdr., Lt. Cdr.). The affiliations of technical reviewers who are not employees of this Station should be given.

FOREWORD

The development of the Part YZ-10 Mk 1 Mod 1 for use with Weapon Z was accomplished at the U. S. Naval Ordnance Test Station as authorized by the Bureau of Ordnance Classified letter Q00-1(23)(Re2b-456)ABC:ch, dated 10 July 1950. By Classified letter Q12-3(456)Re3d-XYZ:ab, dated 22 September 1950, the Bureau of Ordnance proposed a series of tests designed to obtain qualitative information about the part.

The cost of the evaluation tests was divided between Bureau of Ordnance Task Assignments NOTS-Re2b-12-3-45 and NOTS-Re3c-654-3-51. The tests were begun on 2 October 1950 and completed on 10 July 1951.

Only a brief description of Part YZ-10 is presented in this report. Full information regarding its design may be found in NAVORD Report 0000, The Design of Part YZ-10 Mk 1 Mod 1.

This report was reviewed for technical accuracy by J. D. Roe, Arthur Johnson, and Cdr. Y. Z. Jones.

FIG. 7. Sample Foreword

C. D. SMITH
Head, Cognisant Department

Released by:
FREDERICK W. BROWN
Technical Director

ABSTRACT

To the Author. An abstract is a brief statement of the essential features of your report. It serves two purposes: (1) it is a device by which a prospective reader can decide whether or not your report contains something of interest; and (2) it is a bibliographical device. The abstract should stand by itself as an epitome of the contents of the report; it should present the subject, scope, and significance of the report, but must not contain anything not included in the report itself. Because abstracts are often reproduced on 3- by 5-inch library cards, they should not be more than 150 words in length. Usually you can tell your story in less. Waste no words on unimportant details. Do not attempt to refer to figures or tables in the report, because the abstract (although printed in all NAVORD reports) is often detached from the report. Try to give the scope of the work covered in the report and the important results. When possible, present actual information rather than indicate the type of information included in the report.

To the Typist. Every Class 2 report must include an abstract. It is typed on a separate page and is located immediately after the foreword. The word ABSTRACT is typed in all caps and centered (see Fig. 8). The remainder of the page should be typed double- or triple-spaced in regular paragraph style. The classification should be typed or stamped at both the top and bottom of the page, and the MS. number should be placed in the upper right corner. The abstract is paginated in Roman numerals as part of the preliminary matter.

ABSTRACT

Two series of evaluation tests were performed at the U. S. Naval Ordnance Test Station, Inyokern, to determine the performance characteristics of Weapon Z, which was developed at the Station for possible use against such targets as supply dumps and factories. The weapon appears to be at least twice as effective against these targets as any other known weapon. It is recommended that Weapon Z be put into production at the earliest possible date.

FIG. 8. Sample Abstract

TABLE OF CONTENTS

To the Author. Most NOTS reports contain a table of contents to indicate to the reader what is in the report and to help him find specific parts readily. If your report is short (say, less than 20 typed pages), there is no need for a table of contents.

Normally, prepare a table of contents listing all primary and secondary headings, beginning with *Foreword*. Secondary headings may be omitted or tertiary headings may be included, depending upon their indexing value; but only long and complicated reports justify entering more than two orders of headings in the table of contents.

The title portions of figure legends are frequently included in the table of contents. Occasionally, however, some or all of the figures do not have legends, or the legends are not distinctive for indexing purposes; when this occurs, none of the legends are entered. In some reports the figures are not important enough to warrant listing.

Most reports do not justify listing the tables. They are included in the table of contents only when they are of special importance and it is essential that the reader be able to find them quickly.

To the Typist. When a table of contents is included, it is begun on a separate page, with the classification typed or stamped at both top and bottom and the MS. number typed in the upper right corner. It is paginated in Roman numerals as part of the preliminary matter. The single word CONTENTS is typed in all caps and centered on the first page. The entries are typed in caps and lower case (see Fig. 9). Double-space all copy. If the figures are to be listed, enter the title portion of each legend under the introductory word *Figures*, which should be inserted below the list of headings (as shown in Fig. 9), but following a centered rule to show discontinuity in pagination. When a list of tables is also to be included, enter the titles below the headings and the figure legends, after a second centered rule and under the second introductory word *Tables*.

Just before the MS. is submitted to TPD, check the table of contents against the actual headings in the report, the figure legends, and the table titles for agreement in wording, spelling, and capitalization. If headings, figure legends, or table titles are too long for convenient use in the table of contents, shortened versions may be used; but they must contain no words that do not appear in the full versions.

CONTENTS

FIG. 9. Sample Table of Contents

TEXT OF THE MANUSCRIPT

To the Author. Every author has his own style, but there are a few features of technical report writing that apply to all. First, consideration should be given to the length of the paragraphs. Paragraphs that are too long make a report difficult to read; those that are too short give a choppy, disconnected effect. The length of a paragraph should be limited to how much your readers can take in at one time. If you expect that your readers will have a good knowledge of the subject, you are free to use long paragraphs with a considerable amount of discussion in each. For inexperienced readers, you must present your ideas a little at a time in short paragraphs.

Strive for accuracy of statement and clarity of presentation. This does not mean that you must use only short words and simple sentences, but that you should use the *right* word and that your sentences should be well constructed and correctly punctuated. Make use of enough transition sentences and paragraphs to enable the reader to follow your presentation without undue difficulty. It is usually better to have too much detail than too little.

To the Typist. Each page of manuscript must carry the classification at the top and bottom and the MS. number in the upper right corner. The text pages should be numbered consecutively with Arabic numerals, beginning with the first page of the actual text as page 1 and continuing through the appendixes and other supplementary matter, such as nomenclature and references. Do not type formal tables as part of the text (see Formal Tables).

The first line of each paragraph should be indented (see Fig. 10), not blocked with extra vertical space, and the text must be at least double-spaced. The left, top, and bottom margins should be 1½ inches. Set the typewriter stops for 60 spaces to a line. Type on one side of the page only. The manuscript submitted to TPD must be either an original ribbon copy or a bright, completely legible, ditto copy. The sheets should be held together in a manila folder by a fastener through perforations in the top margin (no staples, please). Corrections, headings, and displayed matter are discussed separately in the following pages of this handbook.

CENTER HEADING

This sheet is typical of pages that carry the text of the manuscript as submitted for publication. You will note that it is typed and is double-spaced. It may be triple-spaced if you prefer. It is important that every letter or symbol be perfectly legible, because the people who set this in type for publication cannot be expected to guess what the author intended to say. They can reproduce only what actually appears. Illegible copy results in errors, delay, and extra expense.

You will note that the paragraphs are indented and that there are ample margins. The double spacing and the large margins are essential because the editor must have enough space to mark the copy for the printer. Even if the text is perfect and requires no changes or corrections, the editor is still required to mark the copy so that the compositors know how to set it up.

When inserting Greek letters by hand or when adding mathematical signs and symbols, take particular care to see that they are legible and that the same form is used throughout the report.

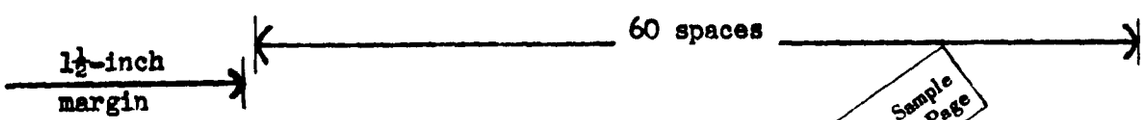


FIG. 10. Sample Manuscript Page

MAKING CORRECTIONS IN MANUSCRIPT

To the Author. The manuscript should be as free of inserted corrections and additions as possible. Except for very short insertions of a few words, avoid handwritten changes. Remember that most handwriting is illegible at times and the person who composes the final copy for printing will not be able to bring queries directly to you. If you are changing more than a few words, have the correction typed as described below to the typist and illustrated in Fig. 11 and 12.

Handwritten corrections must be made in ink (blue or black, never red) as follows: Cross out deletions. Enter a short insertion (less than one line) in the space above the pertinent line of text and mark the exact place with a caret (∧). Do not make changes on MS. in pencil of any color, because the editors and copymarkers use a color code in marking copy, and colors that you might use would lead to confusion.

To the Typist. Corrections of one line or more should be typed on a separate sheet (see Fig. 12). Each correction sheet must carry the classification at the top and bottom and the MS. number in the upper right corner. It should be identified by the number of the page it corrects or supplements plus a letter (for example, 6a would be the number of the first sheet of insertions for page 6). The insertion should be keyed to its place in the text by marking that place with a caret, writing the words *Insert from p. 6a* (see Fig. 11) in the margin in ink and drawing a line from this note to the caret. A corresponding key saying, for example, *This copy to be inserted on p. 6* should be typed on the correction sheet just above the new copy.

CLASSIFICATION 00/MS-000

Not all the work of the Station is done in the remote desert, however. Research devoted to underwater ordnance is carried on at a large annex in Pasadena, which operates a water range high in the mountains near Azusa.

Insert from p. 6a

The U. S. Naval Ordnance Test Station is a unique establishment in many ways. Both the Navy and its civilian scientists regard the policies set up for its operation as an outstanding example of coordination in an effort to keep this nation far ahead of all others in . . .

CLASSIFICATION 6

FIG. 11. Sample Corrected Page

- -

CLASSIFICATION 00/MS-000

This copy to be inserted on p. 6.

Most significant, perhaps, is the form of its organization, which places the direction of research under civilian control--a new idea for military scientific centers.

FIG. 12. Sample Correction Page

CLASSIFICATION 6a

HEADINGS

To the Author. Headings serve two purposes in a technical report: they indicate the plan for presenting the material to the reader; and they serve as guides for the reader who uses the report as a reference work. The choice of type font and size and the physical location of the various headings give the reader a visual indication of the relation of the parts of the report to each other. Headings, therefore, must be selected with care and located logically and precisely. They should be thought of, not as entries in an outline, but as guideposts inserted for the convenience of the reader after the report is written. The text must not depend on the headings, but should read continuously, except where subordinate headings are topics and comments.

Headings should be as brief as possible; do not use articles (*a, an, the*) unless they serve some useful purpose. Use title style, rather than sentence style, and keep punctuation to a minimum.

It is your responsibility to determine the logical order of the headings and their wording. Parallel sections should have parallel headings. Major sections of a report are given primary headings. A major section may be divided into several parallel subsections, which are identified by secondary headings. These subsections, in turn, may be divided again and the sub-subsections distinguished by tertiary headings. This process may be continued as far as necessary but should not be overdone, especially in short reports.

To the Typist. Since a typewriter has only one font, the variety of MS. heading styles is limited. It is simple, however, to distinguish five orders of headings, and these are enough for the average technical report (see Fig. 13). When less than five styles of headings are required, the choice will depend upon the purpose of the subordinate headings. If you have a situation that calls for special types of headings or have questions on how to use the headings shown in Fig. 13, get the advice of the editors in TPD. They are familiar with the type fonts available to the TPD compositors and have the experience necessary to give you practical solutions to your problems.

PRIMARY HEADING

Primary headings in manuscripts of technical reports are typed in all caps and centered. If a heading is two lines or more, type it as an inverted pyramid. When one occurs within lines of text, leave three spaces after the preceding text and two spaces between it and the following text.

SECONDARY HEADING

A flush-left heading should never be typed completely across the page. Stop at least 1 inch short of the right margin and type it on two or more lines, with all lines beginning flush left.

FIG. 13. Sample Typewriter Headings

Tertiary Heading

The tertiary heading is similar to the secondary heading but is typed in caps and lower-case letters and underscored. Use no end period with headings set out from the text.

FOURTH HEADING. The next logical possibility on the typewriter is the run-in heading typed in all caps. Note that run-in headings may govern several paragraphs.

Fifth Heading. The fifth possibility is the underscored run-in heading typed in caps and lower-case letters. Use an end period and two spaces after headings followed by text on the same line.

USE OF DISPLAYED TEXT

To the Author. In presenting a technical report upon a research, development, or test project, you may wish to make important items stand out on the finished page and catch the eye of the reader. This may be accomplished by "displaying" major statements or topics with special indention and spacing. Displayed material is also readily accessible to a reader who is using the report for reference purposes. The use of displayed text is illustrated in Fig. 14.

In preparing copy for display, certain features must be kept in mind: (1) The point of view of the items must be parallel (i.e., if one item is in sentence style, all must be in sentence style). (2) The tense of the verbs must be consistent from item to item. (3) The style must be consistent, i.e., you must not switch back and forth from the imperative to the normal style of sentence construction.

To the Typist. One common style used for displaying text is referred to as the numbered-paragraph style (see top of Fig. 14). It is used when the items to be displayed are relatively long. Such items are usually in sentence form but may also be very long and involved topical listings. The first line of each item is indented, but the following lines are brought out to the left-hand margin of the typed page. These items require end periods. Note that the paragraph numbers are not enclosed in parentheses but are followed simply by a period and two spaces.

A second style (bottom of Fig. 14) is referred to as hung or stepped-off display. It is used to call attention to a series of relatively short items, which may or may not be sentences. In this style, the item number, or the first word of unnumbered items, is typed at normal paragraph indention. If a numbered item runs to more than one line, its second line is indented to align with the first word of the first line. In an unnumbered series, second lines are indented (hung) an additional amount, usually equal to the paragraph indention. If none of the items is a sentence, no end periods are used; but if any one of the items is a sentence, a period is placed at the end of every item.

This is a sample of displayed text in typewritten manuscript when the items are comparatively long. In order to make the best use of the page, the items are brought out to the full measure. Suppose we list a few steps in the process of preparing a report, as follows:

1. Before the author starts writing his copy, he should gather all his notes and review them carefully so that he is familiar with the details of his project.

2. Then he should write a rough draft of the report. He will find that, if he is anything less than a genius, he will need some sort of plan for his writing so that his presentation will be logical.

3. Eventually, the manuscript will be turned over to a typist who will prepare copies to be sent to the reviewers.

This is a sample of displayed text in typewritten manuscript when the items are comparatively short or are not sentences, listing the materials required by an author:

1. Work sheets
2. Tables of basic data
3. Photographs, if available, to be reproduced as halftones in the printed report
4. Drawings
5. Specifications

FIG. 14. Sample of Displayed Text

EQUATIONS AND FORMULAS

To the Author. Many NOTS technical reports contain complex mathematics which is expensive to publish. However, the expense can often be reduced, without sacrificing clarity, by changing complex forms to simpler versions. For example: (1) Use solidus (/) instead of horizontal-bar fractions when possible; likewise, use negative exponents with parentheses or brackets instead of fractions; and simplify expressions like $\frac{1}{2}C_D$ to the form $C_D/2$. (2) Change radical signs to fractional exponents, with brackets or parentheses. (3) For exponential functions (e with complex exponent), use the abbreviation exp followed by the exponent in parentheses or brackets. (4) Substitute a convenient symbol, explained in the nomenclature, for frequently occurring complex expressions (see Appendix A for suggestions).

In chemical matter, use the standards of *Chemical Abstracts* for spelling, hyphenation, capitalization, parentheses, and italics.

All symbols must be made completely legible. Subscripts, superscripts, and prime marks can best be indicated by careful placement in relation to the basic symbol. Italic may be underscored, or this marking can be left for the TPD editors to do. Clearly distinguish upper-case from lower-case letters, zero from the letter *o*, the numeral one from the letter *l* and the prime (′), and Greek letters from similarly shaped English letters. Take exceptional care when the symbols are handwritten.

To the Typist. In preparing copy for equations (see Fig. 15), be careful to locate each sign and symbol accurately with respect to the others. Place subscripts and superscripts, respectively, half a line above and below the main line. Place sub-subscripts half a line below subscripts. Equals signs should be on the same level as horizontal fraction bars.

Equations displayed one below another with no intervening text may be aligned vertically on the equals signs, or each line may be centered. When an equation exceeds one line, break it at a mathematically permissible point (if in doubt, ask the author).

If the major equations are to be numbered, place the numbers in parentheses and flush with the left margin, unless the author specifically requests that they be located flush right. The equations should be numbered in a single series throughout the text and the appendixes, if any.

Here is an example of a group of equations having each line centered individually. Note placement of subscripts, sub-subscripts, and superscripts; also omission of underscoring with chemical symbols.

$$P_{N_2} = (T/K_6)^2$$

$$P_{NO} = ZK_1T$$

$$(P_{NO} + 2P_{N_2})/U = \gamma$$

FIG. 15. Sample Equations

This is an example of a group of equations aligned on equals signs:

$$(\tau + Y)R_{M_g} = (M + L)^{1/2}$$

$$U = S\left\{S\left[2(K_7Z - 1)\right] + K_8Z + K_4\right\}$$

$$T = \left[(K_{11}Z)^2 + UK_5\right]^{1/2} - K_{11}Z$$

This is an example of one equation set on two lines:

$$\beta U = \frac{\gamma U}{2} + \frac{\alpha U}{2} - \frac{UB}{2(1 - Z)}(2Z + 1) + S^2 + \frac{K_7ZS^2}{2} + SK_4 + \frac{K_9ZS}{2} + K_{10}Z$$

This is an example of numbered equations:

The above quadratic coefficient of S^2 reduces to

$$Z^2K_7B + Z(K_7C + 2\delta) + 2D = 0 \tag{6}$$

or

$$Z^2K_a + ZK_b + 2D = 0 \tag{7}$$

APPENDIXES

To the Author. Material that supplements the main body of a technical report, but is not an integral part of it, is usually placed in one or more appendixes located after the conclusion of the main text. That is the logical place for basic data that should accompany the report but would lead to confusion if it were inserted in the main text. It is also a good idea to put in appendixes such supporting information as detailed specifications, complicated mathematical derivations, and similar material that should be recorded but is of little interest to the majority of readers.

An appendix usually includes some text, but occasionally contains only a series of figures or tables. With few exceptions, the figures and tables are numbered in the same series as those in the body of the report. Each appendix should be mentioned in the body of the report. If there is only one appendix, it is called simply the *Appendix;* but if there is more than one appendix, each is identified by a letter: *Appendix A, Appendix B.*

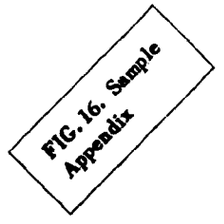
To the Typist. Copy for appendixes (see Fig. 16) is prepared in the same manner as that for the body of the report: typed double-spaced, identified by the MS. number, and marked with the classification at the top and bottom of each page. Begin each appendix on a separate page. Type *Appendix* or *Appendix A* in capital and lower-case letters at the top of the first page. Below it type the appendix title in all caps. Then proceed as with normal MS. copy.

Appendix A

APPENDIX TITLE CENTERED, ALL CAPS

The normal appendix is comprised of text, tables, and figures prepared in the same form as the copy for the body of the report. If an appendix is long, it may contain various headings of the type illustrated in Fig. 13. The title is considered a primary heading.

If you have a derivation that makes use of numbered equations, number them in the same series as those in the body of the report (unless, of course, the matter has been taken intact from another source). For example, if the last equation in the body of the report is numbered Eq. 26, the first one in the first appendix should be numbered Eq. 27. Actually, the material in an appendix might have been a part of the body of the report, but for the convenience of the majority of readers it has been lifted out and placed at the end of the main text.



NOMENCLATURE

To the Author. When a considerable number of symbols have been used in a report, it is desirable to list these symbols and their definitions in one place for the convenience of the reader. A list of nomenclature is normally prepared as a separate subdivision of the report with its own heading. The nomenclature is usually located at the end of the report, after the appendixes, if any. It should be listed in the table of contents.

These lists are usually set up in alphabetical order (see Fig. 17), with letter symbols from the English alphabet grouped first, followed by the Greek letter symbols, subscripts, superscripts, and special notes when used. Care should be taken to list all the symbols used in the report. To avoid confusion, no symbol should have more than one definition. Unless it is unavoidable, do not use a lower-case "aye" (a) and a lower-case alpha (α) as symbols in the same report. Their joint occurrence requires special time-consuming treatment in TPD because of the limitations of the type fonts currently available. Check to be sure that the definitions given in the list of nomenclature agree with those given in the text.

To the Typist. The list of nomenclature should be typed on a separate page. It is normally located immediately preceding the list of references. Identify the page, as usual, with the MS. number, classification at the top and bottom, and the page number. Equals signs are not used between the symbol and the definition. The first word of each definition should begin with a capital letter, except when the definition begins with a lower-case mathematical or other special symbol. The symbols should appear on the left of the page separated from the definitions by two spaces. Align the symbols on the right and the definitions on the left, as shown in Fig. 17. Underscore all letters from the English alphabet that are to be set in italics. Note that such abbreviations as sin, csc, and exp (as well as max, min, and av used as subscripts) are not to be set in italics, in contrast to mathematical letter symbols. If Greek letters are entered by hand, be sure that they are legible. Do not underscore Greek letters.

NOMENCLATURE

A	Area, ft^2
F	Force, lb
H	Hinge moment, ft-lb
I_1	Polar moment of inertia, slug-ft^2
I_2	Transverse moment of inertia, slug-ft^2
I_g	Gyro moment of inertia about rotation axis, slug-ft^2
L	Aerodynamic rolling moment, ft-lb
M_x	Gyro precession moment about hinge axis, ft-lb
M_y	Gyro precession moment about roll axis, ft-lb
R	Aerodynamic moment due to rolleron, ft-lb
V	Velocity, fps
α	Angular acceleration, radians/sec^2
β	Friction factor, lb-sec
δ	Deflection angle of rolleron, radians
θ	Angle of roll of missile, radians
ω	Angular velocity of gyro wheel, radians/sec

FIG. 17. Sample List of Nomenclature

COPY FOR FIGURE LEGENDS

To the Author. Every figure must be numbered and under normal circumstances must carry a legend (sometimes called a caption). The author should take pains to make his legends clear and complete with a minimum number of words. Frequently, a basic title is given telling what is shown in the figure, and this is followed by additional information in the form of notes or comments, which may be in sentence form.

While legends must describe the figures, it is not a requirement that each figure and legend stand alone. If you have a figure comprised of two or more parts, identify the parts with lower-case letters and point out in the legend the difference between the parts (see item 8, Fig. 18). If you wish to call out a number of features within a figure or part of a figure, identify them by the use of capital letters; again, be sure to describe all such features in the legend (see item 7, Fig. 18).

Figures should be numbered with Arabic numerals in the order in which they are mentioned in the text. There should normally be only one series of figure numbers, beginning with *Fig. 1* for the first figure mentioned and running consecutively through the entire report, including any appendixes.

To the Typist. A separate list of figure legends (see Fig. 18) should accompany the manuscript of a report when it is submitted to TPD. The pages should be identified with the manuscript number and should be marked with the classification at the top and bottom. The list should be headed COPY FOR FIGURE LEGENDS. The copy should be double-spaced and each legend should be complete, including the basic title and additional information (see item 5, Fig. 18). Each legend should be blocked flush left. The abbreviation *FIG.*, should be typed in all caps. The main portion of the title should be typed in caps and lower-case letters. (For proper capitalization, see the section on Capitalization in this handbook.) Additional information should be continued on the same line as the basic title and should be typed with sentence capitalization and punctuation. Every legend should have an end period.

COPY FOR FIGURE LEGENDS

FIG. 1. Blanc's Observatory at an Elevation of 11,050 Feet at the White Mountain Research Station.

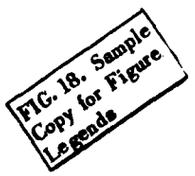


FIG. 2. Optical Parts of the CI Spectroscope.

FIG. 3. IBM Computer Room at Michelson Laboratory.

FIG. 4. Thrust Stands and Oxidizer Tank in Liquid-Propellant Static-Test Facility.

FIG. 5. Two-Dimensional Example With Two Fixed Stations, S_1 and S_2. The missile, whose approximate position is (X_0, Y_0), is free.

FIG. 6. Linear Dependence of the Change of Capacitance on Air Density. Pressures ranged from 0 to 1,000 psi; temperatures, from 25 to 150°C.

FIG. 7. Exploded View of Weapon Z. (A) Nose plug, (B) head, (C) fuze, (D) motor, (E) grain, and (F) fins.

FIG. 8. Pressure as a Function of Time for Weapon Z. (a) At Mach 2.50 and a temperature of 80°C, and (b) at Mach 2.00 and a temperature of 60°C.

COPY FOR FOOTNOTES

To the Author. Footnotes to text should be numbered serially throughout the text, including the appendixes, if any. They should generally be referenced by superior Arabic numerals placed after the items to which the footnotes apply. This numbered series should include footnotes to text tables, but not the footnotes to formal tables. Do not use asterisks or similar devices for referencing footnotes to text.

Footnotes are normally written in sentence style, with usual punctuation. However, they need not be complete sentences when a word or phrase will do. They fall into two classes: bibliographic notes and notes that give additional information. Bibliographic footnotes are used when your references are relatively few in number, are widely spaced and only incidental in a long report, or when they pertain to unpublished or inaccessible material. The detailed handling of such footnotes is discussed under Bibliographic Footnotes.

Footnotes of the comment type are used when you want to refer to correspondence, a report in preparation, a local technical memorandum, or similar items inaccessible to the reader. They are also used to present information or comments pertinent to the text, but not an integral part of it. It is permissible to use a short table or other displayed matter in a footnote.

To the Typist. If footnotes appear in a report that you are typing, a list of footnotes (see Fig. 19) should accompany the manuscript when it is submitted to TPD. These should be typewritten (double-spaced) in numerical order, with text page numbers indicated. The list should be headed COPY FOR FOOTNOTES, and should carry the same classification at the top and bottom of the page as appears on the rest of the report. The manuscript number should, as usual, be located in the upper right corner.

The first line of each footnote should be given paragraph indention, and the following lines brought out to the full measure of the page. Footnotes should be typed with sentence capitalization and punctuation. Be sure that all symbols and Greek letters are clear and legible.

Footnotes may also appear on the pertinent manuscript pages, if the author so desires for the convenience of his reviewers, but this is not a requirement of TPD. For publication purposes, the list of footnotes is the requirement.

COPY FOR FOOTNOTES

MS. Page

[1] Hammond, C. R., and others. "28-Volt Operation of Receiving Tubes," in Electronics for Engineers, ed. by John Markus and Vin Zeluff. New York, McGraw-Hill, 1945. Pp. 360-64. 2

[2] Mathematical Methods of Statistics. Princeton, N. J., Princeton Univ. Press, 1946. 4

[3] From a personal letter from L. M. Jones to J. D. Roe, dated 16 September 1951. 12

[4] This section was prepared by K. Y. Zelder, Head, Department of Physical Chemistry, California Institute of Technology, Pasadena, California. 17

FIG. 19. Sample Copy for Footnotes

METHODS OF CITING LITERATURE

To the Author. In technical reporting you cannot escape making references to other scientific or technical documents pertinent to the project, and you must occasionally prepare a bibliography. But keep in mind that, whereas a complete and correct bibliographical entry (see Fig. 20a–c) enables your reader to locate the item quickly, a defective one wastes his time and may raise doubts about your accuracy in other details. Remember, also, that it is dangerous to list a reference second hand, unless you note that fact; do not jeopardize your good name by trusting another's interpretation of a third person's work.

As author, it is your responsibility to supply full and exact bibliographical data in your manuscript. Save yourself time by developing the habit of recording systematically each item of interest you find in the literature. In making your notes, be careful to preserve the spelling, capitalization, and hyphenation of the source. Title-page information is considered authoritative; the card index in a library is usually reliable.

The following check list is a guide to the information you will want when you prepare your list of references or bibliography:

Name of author or issuing agency. (For bibliographical purposes the "author" of a publication issued officially by an agency or institution is the agency that released the item. To give complete credit, the name of the *personal* author should always be included when available, but after the title; also that of the translator or editor.)

Edition, if other than the first. (Content and pagination changes with edition.)

Place, publisher, and date (the facts of publication).

Volume, chapter, and pages, when pertinent. (Always important with periodicals.)

Series title and number, when the item carries such identification. (For example, the NAVORD report number.)

Security classification, if any question of classification is involved. (Indicate as *UNCLASSIFIED* an unmarked item from a series usually carrying a security classification. This word may be omitted in the published report, but should be included in the manuscript to make verification unnecessary during publication.)

The examples in Fig. 20a–c illustrate most of the variations encountered, but as a group rather than for each type of item.

Book—simple reference, one author:

Olson, Harry F. Elements of Acoustical Engineering. New York, Van Nostrand, 1947 (1)

Book—other than first edition; pagination given:

Nelson, J. Raleigh. Writing the Technical Report, 2nd ed. New York, McGraw-Hill, 1947. 388 pp. (2)

Book—no author or editor given:

Webster's Collegiate Dictionary, 5th ed. Springfield, Mass., G. & C. Merriam Co., 1946. (3)

Book—translation; authors and translators both given:

Zechmeister, L., and L. Cholnoky. Principles and Practices of Chromatography, tr. by A. L. Bacharach and F. A. Robinson. New York, Wiley, 1941. 362 pp. (4)

Book—foreign language, with English title supplied:

Cranz, C. Lehrbuch der Ballistik. Zweiter Band. Innere Ballistik. (Textbook of Ballistics. Part 2. Interior Ballistics.) Berlin, Julius Springer, 1926. (5)

Book in a Series—editors but no author given:

Smullin, Louis D., and Carol G. Montgomery, eds. Microwave Duplexers. New York, McGraw-Hill, 1948. (Massachusetts Institute of Technology, Radiation Laboratory Series, Vol. 14.) (6)

Chapter in a Book—with title and pagination given:

Worthing, Archie G., and Joseph Geffner. Treatment of Experimental Data. New York, Wiley, 1943. Chap. 2, "Representation of Data by Graphs," pp. 29–55. (7)

FIG. 20a. Patterns of Bibliographical Entries: Books

Figure in a Book—with page indicated:

Wimpress, R. N. Internal Ballistics of Solid-Fuel Rockets. New York, McGraw-Hill, 1950. Fig. 14–17, p. 157. (8)

METHODS OF CITING LITERATURE (Contd.)

To the Author. You will seldom wish to include bibliographical details in the running text of a report. Instead, you may write some brief identification into the text—author's name, title of the item, reference number, or a combination of these—and place the full citation in a bibliographical list or footnote. Or you may occasionally wish to give part of the information in the text and the rest in a footnote. Furthermore, you will often find it desirable to list items that you do not care to reference specifically. You have a choice, therefore, of one or a combination of these methods of presenting bibliographical data: (a) list of references keyed to the text; (b) bibliography, with or without some items keyed to the text; (c) bibliographical footnotes; and (d) complete citations in the text. Examples of the first three of these methods are given in Fig. 21–23.

For lists and bibliographies, a basic pattern has been chosen that provides maximum uniformity and economy, while permitting the necessary minor adjustments for different types of items. Essentially, the order of presenting the bibliographical data is that of the check list above, which conveniently follows the order on standard library index cards. Special type faces are strictly avoided to permit the same typographical style to be used in preparing manuscripts and composing technical reports on standard typewriters. The pattern for each specific entry is the same whether it appears in a numerical or alphabetical list.

Types of items vary so greatly, however, that in effect a number of subpatterns result. These are illustrated by the examples in Fig. 20a–c. Note that the normal variations within each element are shown in the examples as a group, not for each type. For instance, the treatment of one author, two authors, and more than two authors is evident by comparing the first, fourth, and twelfth examples. The punctuation between elements is part of each subpattern, but further minor adjustments may occasionally be necessary.

Bibliographical lists and footnotes as finally printed will show the titles of periodicals in the standard abbreviated form you will find in Special Report 556-1, *Abbreviations of Periodical Titles for Use in NOTS Technical Reports,* issued in January 1951, copies of which are available from the Technical Publishing Division. The style is all capitals without periods. In your manuscript, use these abbreviations of periodical titles (but no others), or give the titles in full.

Article in a Bound Collection—different authors, one editor:

Keohler, Glenn. "Design of Class B and AB Output Transformers," in Electronics for Engineers, ed. by John Markus and Vin Zeluff. New York, McGraw-Hill, 1945. Pp. 52-54. (9)

Article in a Dictionary or Encyclopedia—no author given:

"Spherometry," in Dictionary of Applied Physics. London, Macmillan, 1923. Vol. 4, pp. 786-97. (10)

Article in a Periodical—volume number and date:

Mindlin, R. D., and L. E. Goodman. "Beam Vibrations With Time-Dependent Boundary Conditions," J APPL MECH, Vol. 17 (December 1950), pp. 377-80. (11)

Article in a Periodical—date without volume number:

Macbeth, A. Killen, and others. "Methods of Resolution. Part III. Variations of the Resolution of Alcohols Through Acid Esters," CHEM SOC (London), J, December 1950, pp. 3538-47. (12)

Official Report—NOTS report, unclassified:

U. S. Naval Ordnance Test Station, Inyokern. Determination of Nitric Oxide and Nitrogen Tetroxide in Admixture, by Gerald C. Whitnack and others. China Lake, Calif., NOTS, 8 August 1950. (NAVORD Report 1246, NOTS 309.)* (13)

Official Report—NOTS report, classified:

U. S. Naval Ordnance Test Station, Inyokern. Recording Instruments Developed for Use on the Ranges. Part 2. Ultra-Speed Cameras, by Joe J. Doakes. Inyokern, Calif., NOTS, 29 February 1949. (NAVORD Report 0000, Part 2; NOTS 000), CONFIDENTIAL.† (14)

Official Report—private corporation or agency:

Northrop Aircraft, Inc. Tests of Navy Bureau of Ordnance Rocket Models, Part I, by K. W. Hunt and R. W. Lucas. Hawthorne, Calif., Northrop, April 1947. (A-WTM-18)* (15)

* Manuscript should include "UNCLASSIFIED."

† Fictitious entry to illustrate a classified item.

FIG. 20b. Patterns of Bibliographical Entries: Articles and Reports

METHODS OF CITING LITERATURE (Contd.)

To the Author. In text, do not attempt to follow the style set up for lists (unless your report is a literature survey with items displayed in list form in the text). Give name of author in normal order and write into your sentence this and any other details you wish to include in the discussion. Underscore the title of a formal publication (italics in printing) to set it off from the rest of the text. Give the name of a periodical in full and treat it in the same way. Use quotation marks to distinguish the title of a subordinate part of a formal publication—chapter in a book, article in a periodical, etc.—and the title of an informal report.

When you encounter complexities not illustrated here, make certain that you supply all available data; leave the detailed arrangement to the editor. If you are faced with the task of preparing a bibliography of formidable proportions, save yourself time and worry by getting editorial advice in advance.

Patent—single registration:

Foster, G. H., and E. F. Williams. Crystalline Materials. U. S. Patent 2,445,478; July 20, 1948. (Assigned to American Cyanamid Co.) (16)

Patent—multiple registration:

Tanberg, A. P., and R. L. Kramer. Nitroguanidine. U. S. Patent 1,679,753; August 7, 1928. (Assigned to E. I. du Pont de Nemours and Co.) Also British Patent 322,427; June 1, 1928. (17)

Paper Presented:

Brown, C. S., and M. L. Luther. "Experimental Studies of Forces, Pressure Distributions, and Viscous Effects on Long Inclined Bodies of Revolution at Mach 2.96," presented at the Bureau of Ordnance Committee on Aeroballistics Symposium, Austin, Texas, 16 November 1950. (18)

FIG. 20c. Patterns of Bibliographical Entries: Patents and Papers

LISTS OF REFERENCES

To the Author. Choose a simple numbered list headed *REFERENCES* when all items are keyed to the text and you make no pretense of presenting a true bibliography or reading list (see Fig. 21).

Arrange the items in numerical order of first mention in the text and place the list at the end of the report. (In a long book with chapters on widely different subjects, a separate list at the end of each chapter may be preferable.)

When you have only a few references—say three in a short report—treat them as footnotes.

In text, identify the items as *Ref. 1, Ref. 2-3,* or *Ref. 1, 3, and 7,* etc., in parentheses or not, as appropriate. Place the identification after the statement amplified by the reference, not in the middle of it; that is, use *It is evident that Jones disagrees* (*Ref.* 2) rather than *It is evident that Jones* (*Ref.* 2) *disagrees.* Expand *Ref.* to *Reference* when it is the first word of a sentence.

In the list, page numbers are essential in references to articles in periodicals or bound collections (Items 3, 8, 9, and 10 of Fig. 21) or when the reference is to specific pages of a book (Items 2, 4, 5, and 6).

To the Typist. Begin the list of references on a separate sheet and place it at the end of the manuscript. Only the distribution list, which will be supplied during publication, will normally follow. The list should be double-spaced. (Disregard the single spacing of Fig. 21-23.)

Do not repeat the name of the author or issuing agency in consecutive entries on the same page, but replace it with a long dash (use 6 hyphens set tight, to be printed as a 3-em dash) followed by a period. Use this long dash to represent only the name or names *exactly* as given in the preceding entry, not to represent the first of several authors.

REFERENCES

1. U. S. Naval Ordnance Test Station, Inyokern. Determination of Nitric Oxide and Nitrogen Tetroxide in Admixture, by Gerald C. Whitnack and others. China Lake, Calif., NOTS, 8 August 1950. (NAVORD Report 1246, NOTS 309), UNCLASSIFIED.*

2. Crans, C. Lehrbuch der Ballistik. Zweiter Band. Innere Ballistik. (Textbook of Ballistics. Part 2. Interior Ballistics.) Berlin, Julius Springer, 1926. Pp. 165-67.

3. Macbeth, A. Killen, and others. "Methods of Resolution. Part III. Variations of the Resolution of Alcohols Through Acid Esters," CHEM SOC (London), J, December 1950, pp. 3538-47.

4. Zechmeister, L., and L. Cholnoky. Principles and Practices of Chromatography, tr. by A. L. Bacharach and F. A. Robinson. New York, Wiley, 1941. Pp. 42-85.

5. Hilditch, T. P. The Chemical Constitution of Natural Fats, 2nd ed. New York, Wiley, 1947. Pp. 175-89.

6. ———. The Industrial Chemistry of the Fats and Waxes, 2nd ed. New York, Van Nostrand, 1941. Pp. 56-80.

7. Northrop Aircraft, Inc. Tests of Navy Bureau of Ordnance Rocket Models, Part I, by K. W. Hunt and R. W. Lucas. Hawthorne, Calif., Northrop, April 1947. (A-WTM-18), UNCLASSIFIED.*

8. Speyer, E. "Interference Spherometer," REV SCI INSTRUMENTS, Vol. 14 (November 1934), pp. 336-38.

9. Keohler, Glenn. "Design of Class B and AB Output Transformers," in Electronics for Engineers, ed. by John Markus and Vin Zeluff. New York, McGraw-Hill, 1945. Pp. 52-54.

10. "Spherometry," in Dictionary of Applied Physics. London, Macmillan, 1923. Vol. 4, pp. 786-97.

FIG. 21. Sample List of References

* "UNCLASSIFIED" shows in manuscript only.

BIBLIOGRAPHIES

To the Author. When you wish to include a reading list made up of entries that are not all specifically referred to in the body of the report, you will want to use a bibliography (see Fig. 22). The entries in a bibliography are arranged in alphabetical order, instead of in the order of citation in text. A complex or lengthy bibliography may be divided into general subjects or other logical classifications when appropriate, with the entries alphabetized within these classifications.

The section may be headed *BIBLIOGRAPHY*, or some suitable variant. Place it in the same position as a list of references.

When any of the items are mentioned in the report and you desire to key the text citations to the bibliography other than by means of the author's name, number the items in the bibliography *after* alphabetizing. Then identify the item in the text as Ref. *n*, irrespective of the order of citation, but otherwise as for a list of references.

In Fig. 22, pagination is given in the form *554 pp.* after some of the entries for books, to illustrate a refinement that is of real value only in complete bibliographies where it is desirable to give the reader some indication of the relative scope of the items. Compare the form *pp. 52–54* used for articles in a periodical or collection to indicate specific location. Library index cards and bibliographies in some fields record preliminary pages also, in the form *xii, 554 pp.*

Note: Bibliographies and check lists for special purposes may require modifications of the pattern to suit the circumstances, for example those in the *Semiannual Technical Progress Report*. See the pertinent instructions.

To the Typist. Figure 22 illustrates a bibliography arranged alphabetically without subject classification or numbering. Note the difference in indention from that used in *References*. The use of vertical spacing, as well as the long dash in consecutive entries by the same author, is the same as for a list of references.

When the items are numbered as well as arranged alphabetically, follow the style shown for a list of references.

Show subject or other classification, if any, by means of underscored center headings with initial capitals (not shown in Fig. 22).

If they should occur, place annotations (author's comments) after the entry to which they apply. Unless they are very short, begin on a separate line, with paragraph indention but without vertical spacing.

BIBLIOGRAPHY

Crans, C. Lehrbuch der Ballistik. Zweiter Band. Innere Ballistik. (Textbook of Ballistics. Part 2. Interior Ballistics.) Berlin, Julius Springer, 1926.

Hilditch, T. P. The Chemical Constitution of Natural Fats, 2nd ed. New York, Wiley, 1947. 554 pp.

———. The Industrial Chemistry of the Fats and Waxes, 2nd ed. New York, Van Nostrand, 1941. 532 pp.

Keohler, Glenn. "Design of Class B and AB Output Transformers," in Electronics for Engineers, ed. by John Markus and Vin Zeluff. New York, McGraw-Hill, 1945. Pp. 52-54.

Macbeth, A. Killen, and others. "Methods of Resolution. Part III. Variations of the Resolution of Alcohols Through Acid Esters," CHEM SOC (London), J, December 1950, pp. 3538-47.

Mindlin, R. D., and L. E. Goodman. "Beam Vibrations With Time-Dependent Boundary Conditions," J APPL MECH, Vol. 17 (December 1950), pp. 377-80.

Northrop Aircraft, Inc. Tests of Navy Bureau of Ordnance Rocket Models, Part I, by K. W. Hunt and R. W. Lucas. Hawthorne, Calif., Northrop, April 1947. (A-WTM-18), UNCLASSIFIED.*

Speyer, E. "Interference Spherometer," REV SCI INSTRUMENTS, Vol. 14 (November 1934), pp. 336-38.

"Spherometry," in Dictionary of Applied Physics. London, Macmillan, 1923. Vol. 4, pp. 786-97.

U. S. Naval Ordnance Test Station, Inyokern. Determination of Nitric Oxide and Nitrogen Tetroxide in Admixture, by Gerald C. Whitnack and others. China Lake, Calif., NOTS, 8 August 1950. (NAVORD Report 1246, NOTS 309), UNCLASSIFIED.*

* "UNCLASSIFIED" shows in manuscript only.

FIG. 22. Sample Bibliography

BIBLIOGRAPHIC FOOTNOTES

To the Author. Use bibliographic footnotes rather than a list of references or a bibliography only when your references (a) are relatively few in number (up to three in a short report), (b) are widely separated and only incidental in a long report, or (c) pertain to unpublished and inaccessible material that should not appear in a formal list.

The closeness of footnotes to text permits you to choose between the limits of the pattern style of the list and the sentence style of the text. Also, a footnote need not repeat information you have already given adequately in the text, such as the full name of the author. The examples in Fig. 23 illustrate typical variations.

Always use the comment type of footnote (or an appropriate statement in text) when referring to correspondence, a report in preparation, a local technical memorandum, or similar items inaccessible to the reader, since formal listing implies that an item has been distributed or is available on request. (Unpublished information of importance should be summarized or reproduced in an appendix, with the permission of the author or cognizant authority.)

To the Typist. Prepare bibliographic footnotes in the same paragraph style as other footnotes and use reference indexes in the same series: i.e., superior numbers for text and superior letters for tables. Copy for footnotes should be double-spaced.

The text style of italicizing titles of books (underscoring on the typewriter) is used consistently in footnotes, to permit introducing comments. However, the list style of abbreviating titles of periodicals is retained to save space. Internal punctuation follows list style when the footnote is in list style; otherwise, use sentence style, although the footnote need not be a complete sentence.

List style, normal complete entry:

" . . . Adjustments can also be made to permit operation at other voltages.[6]"

6 Hammond, C. R., and others. "28-Volt Operation of Receiving Tubes," in Electronics for Engineers, ed. by John Markus and Vin Zeluff. New York, McGraw-Hill, 1945. Pp. 360-64.

List style, but only to complete the text:

" . . . In general, the methods described by Harald Cramer[7] were applied."

7 Mathematical Methods of Statistics. Princeton, N. J., Princeton Univ. Press, 1946.

Text style, complete entry beginning with a comment:

[8] For further details see H. Dennis Taylor, A System of Applied Optics, London, Macmillan, 1906.

Text style, complete entry followed by comment including two more complete entries:

[9] Speyer, E., "Interference Spherometer," REV SCI INSTRUMENTS, Vol. 14 (November 1934), pp. 336-38. See also "Spherometry" in Dictionary of Applied Physics, London, Macmillan, 1923, Vol. 4, pp. 786-97; and L. C. Martin, Optical Measuring Instruments, New York, Van Nostrand, 1924, pp. 166-75.

Text style, to reference a report in preparation:

[10] The equations used to calculate these values are presented in more detail in a report in preparation on the interpretation of firing data.

FIG. 23. Sample Bibliographic Footnotes

Text style, to reference correspondence:

[11] On the basis of preliminary data reported in a memorandum from A. B. Chuffey to D. E. Furnace, dated 2 June 1949, on the subject: Transformation of kinetic energy into heat as a result of turbulence and wall friction.

ILLUSTRATIONS: PHOTOGRAPHS

To the Author. You will want to make good use of photographs in your reports, but illustrations should be limited to those that definitely serve some useful purpose. Never include a figure for decorative purposes only.

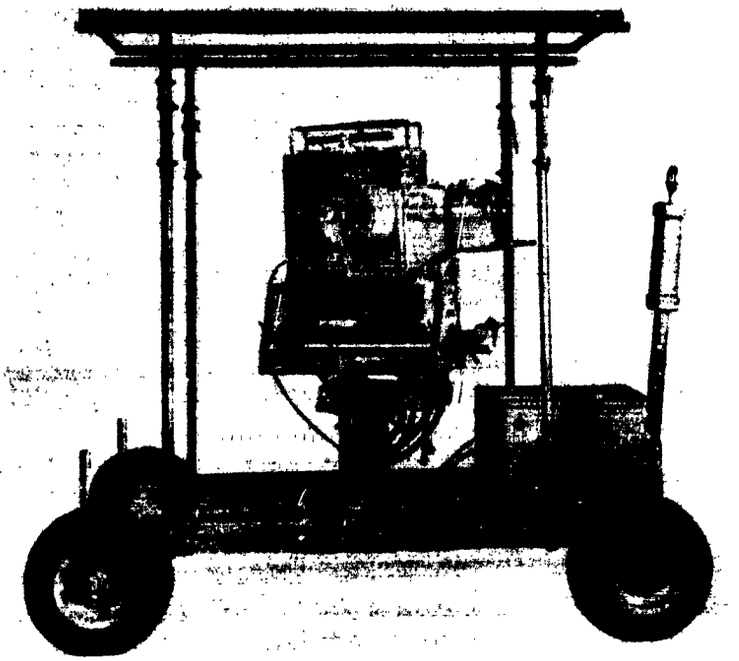
The TPD has a staff of competent illustrators who, in addition to their regular work of producing scientific and engineering illustrations in all media, can be very useful to you in retouching your photographs to bring out the main objects of interest. It is important, however, that the print show the subject to best advantage. For example, do not submit a picture of an entire airplane if you are interested only in the method of attaching rockets to the underside of the wing. Be sure that the photographer knows the exact section or area which is of importance and must be emphasized. Pay particular attention to the angle from which the picture is taken. In general, do not include people in a picture, unless their presence helps to indicate the size of an item or to explain an operation.

To the Photographer. A great deal of time can be saved in the processing of technical reports if the photographs submitted as illustrations have been taken with their ultimate use in mind. For good reproduction (see Fig. 24), a photographic print must have (1) good lighting, (2) sharp detail, (3) proper contrast, (4) distinct plane areas, and (5) an uncluttered background.

In taking photographs in the field, a special effort should be made to remove from the range of the camera all miscellaneous items not pertinent to the picture, such as boxes, ladders, and cars. If they are eliminated before a picture is taken, a great deal of retouching time can be saved.

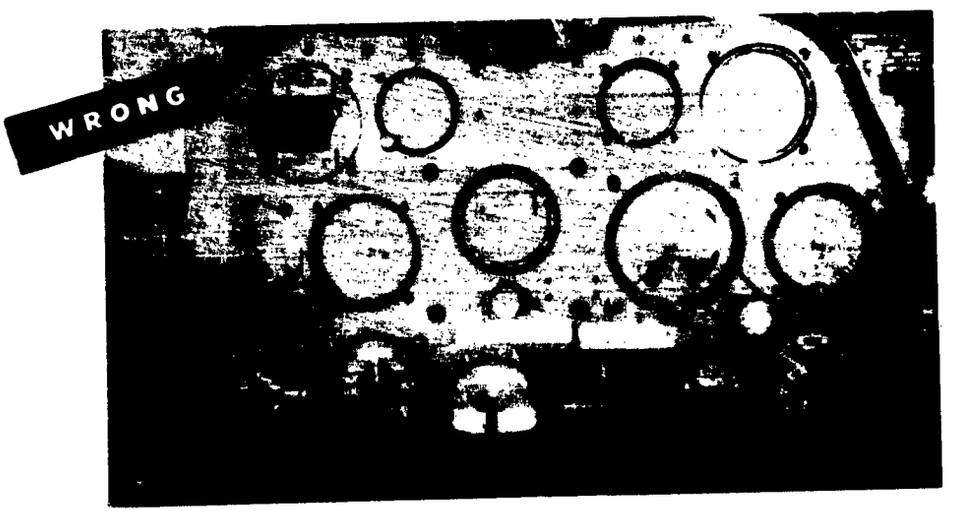
To bring out detail, especially in shadowy areas, it is often necessary to concentrate light on the desired detail independently of the main subject. Make ample use of floods, spots, and reflected light, and give extra attention when the item is of dark material. Outdoor work often requires auxiliary lighting to "fill in" shadow areas.

Since retouch artists usually cannot rearrange parts in a print, you must take considerable pains in composing a picture. For example, in an exploded view of a weapon the parts should be arrayed upon a contrasting, smooth, non-textured material, in the proper assembly order, and centered in planes parallel to one centerline.



Sample of a Good Photograph. Note the sharp focus, good lighting, distinct plane areas, and uncluttered background.

FIG. 24. Sample of Good and Bad Photographs



Sample of a Poor Photograph. Note that the detail is missing. Needs correct lighting and sharp focus. This photograph would be extremely difficult to retouch successfully. (From p. 31 of *AN Guide to Proper Preparation of Technical Handbook Art.*)

ILLUSTRATIONS: PHOTOGRAPHS (Contd.)

To the Author. Many authors, in an effort to show the reader exactly how their records looked, submit photographs that are extremely difficult to reproduce. For example, it is quite common to find photographs of actual oscilloscope tracings included in the art accompanying a manuscript. If these prints are of such a nature (i.e., continuous tone) as to require halftone reproduction, some definition of the trace will be lost in the processing. Therefore, in order to get an end result that faithfully duplicates the original, the oscilloscope tracings must be over-emphasized by retouching. In many situations it may be advisable to make a line-drawing copy of an oscilloscope trace and print it as a line drawing in the final report, even though it may not exactly duplicate the original record.

It is often helpful to label ("call out") the various parts of photographs of equipment. This can best be done by attaching a sheet of vellum over the face of the print and marking the callouts on this overlay. (Do this marking only over a print from the set to be used for editing, never over one to be used for reproduction. See below.) If few items are called out, use the full description; if the callouts are numerous, use key letters and describe them in the legend (see Fig. 25).

To the Typist. Two complete sets of photographs should accompany a manuscript. One set is to be used for editing; the second is to be used for retouching by the TPD artists. Only glossy prints should be submitted. The second set should be carefully protected from damage of any sort, but the prints should not be mounted. It is best to place the prints between sheets of cardboard in a separate envelope. Do not write on the face of these prints or on paper resting on them. Any pressure will dent the finish, and the dent will show in reproduction. Writing on the back will produce the same result. Dents made by paper clips are also likely to show in reproduction. Stamp the classification lightly on the back of the print near the edge, avoiding the area of the print that is to be reproduced; the ink often creeps through to the face of the print and makes it unfit for use. Never fold or roll prints.

Every print of both sets should be identified by writing the figure number and the manuscript number on the back along one edge. Legends should not be attached to the face of prints. They are handled separately (see Copy for Figure Legends).

Typical Photograph in Which the Important Parts Are Identified by Callout Letters. These parts are then described individually in the legend.

FIG. 25. Sample Photograph With Parts Identified by Letters

ILLUSTRATIONS: DRAWINGS

To the Author. There are many situations in which a particular item can be illustrated better by a line drawing (see Fig. 26) than by a photograph. This is particularly true if dimensions of the parts are to be given or if several views (end view, side view, and sections, for example) are to be shown. However, an illustration suitable for use in a report should not contain information that is not pertinent to the discussion. Ordinary production drawings, therefore, are not acceptable. If a print of a production drawing is submitted to be worked up by the TPD artists, the author should mark for deletion all unnecessary dimensions, tolerances, callouts, notes, and details. BuOrd sketches are not to be reproduced in technical reports, but may be referenced or listed (preferably in an appendix).

Callouts on drawings should be as brief as possible. Particular care should be taken to select short callouts for large and complicated figures that will have to be reduced before they can be published. If callouts must be long, or if there are a great many of them, it may be advisable to index the points with identifying letters or numbers which then should be explained in the legend. It is more effective to use several figures to show all details of an item rather than to rely on a complicated and cluttered drawing to carry your story. The space on a report page that can be used for an illustration is 5 by 8 inches, and this must include the figure legend. The normal style of lettering on finished illustrations is vertical and all capitals (see Fig. 26), except for mathematical letter symbols, Greek letters, chemical symbols, and miscellaneous signs, which should be in the appropriate style.

Abbreviations should be used freely, but care must be taken to be consistent in their spelling and in the use of periods (see Abbreviations).

Drawings accompanying the manuscript need not be in finished form (pencil work and photographic prints of originals are acceptable), but all details must be complete and clear. If an original drawing or art work is to be borrowed or salvaged from another publication, it should be so noted along with conditions of availability. Figure legends should not be lettered within the limits of the figure; these are listed separately with the manuscript and are set in type below the figure.

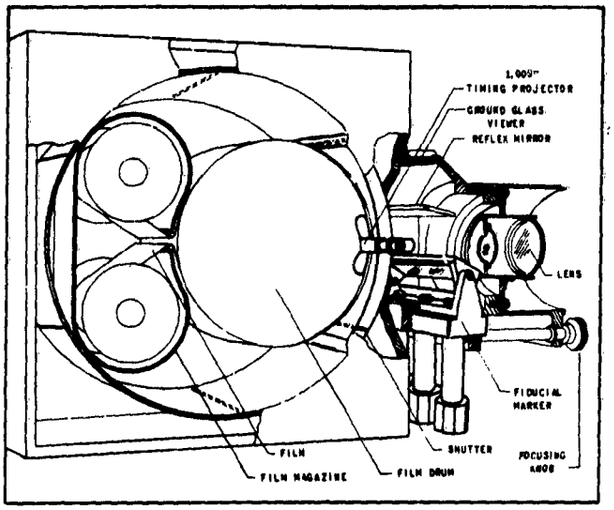
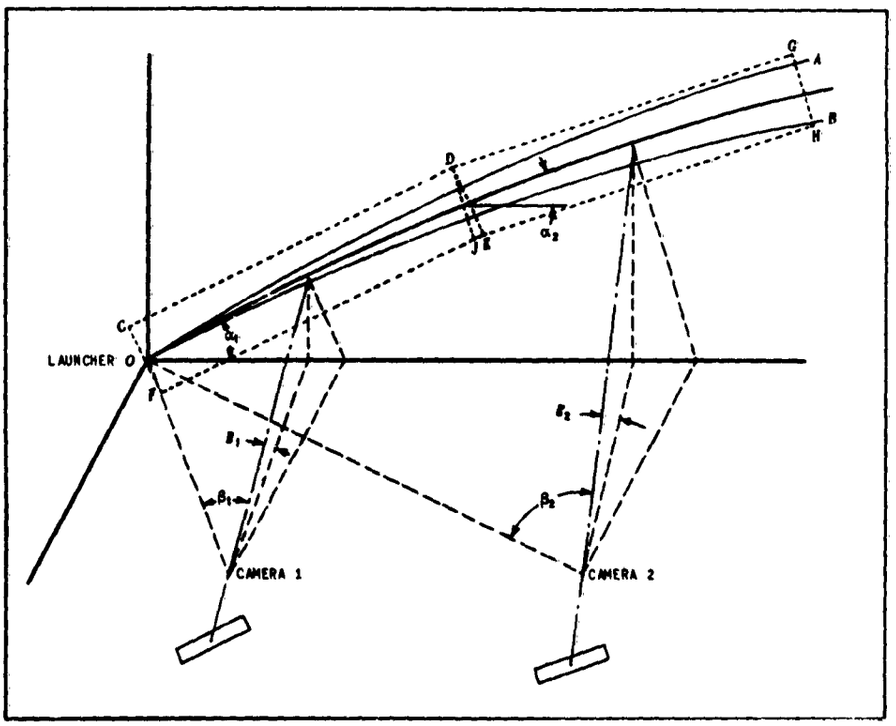


FIG. 26. Sample Drawings

Typical Cutaway Drawing for Use in Technical Report. Note use of callouts, style of letters, and relative line weights.



Typical Figure Used To Illustrate Mathematical Discussion.

ILLUSTRATIONS: GRAPHS

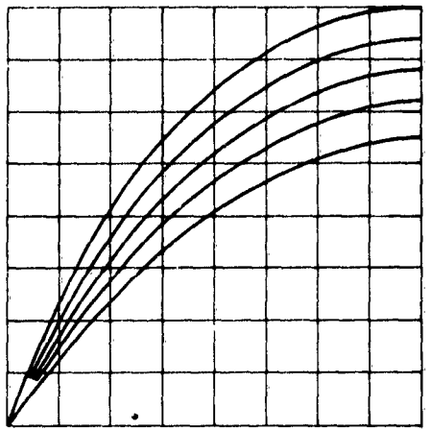
To the Author. The suggestions here pertain to line graphs that show the relationship between two variables in rectangular coordinates, but many of the principles and practices are applicable to other types of graphs and other coordinate systems.

A graph should be used when it will convey information and portray significant features more efficiently than words or tabulations. The following general rules should prove helpful. The simpler a graph, the smaller it may be; the more important it is, the larger it may be. A graph should be designed to require minimum effort on the part of the reader (see Fig. 27); consequently it should be of a familiar form. It should be free of all lines and lettering that are not essential to the reader's clear understanding of its message. Supplementary data or formulas are undesirable on the ruled area of a graph and should preferably be placed in the legend or in the text. Ordinarily, not more than three or four curves should be shown on the same graph.

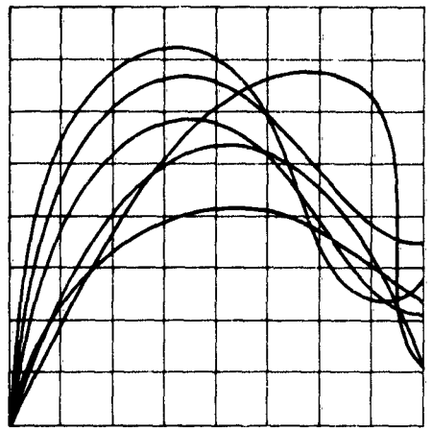
Very careful consideration should be given to the choice of scale (see Fig. 27), since this has a controlling influence on the apparent rate of change of the dependent variable. The TPD is not in a position to redraw graphs at different scales, so the figures must be drawn to the most desirable scale when submitted.

When more than one curve is presented on a graph, relative emphasis or differentiation of the curves may be secured by using different types of line (solid, dashed, dotted, etc.). The most important curve should be a solid line. Observed points should be indicated by open circles unless crossing curve lines require a variety of symbols. Circles, squares, and triangles are preferable to crosses, diamonds, or other symbols; and open symbols should be selected before filled-in symbols (see Fig. 28).

When more than one curve is presented on a graph, each should bear a suitable designation. Preferably, brief labels should be placed close to the curves (horizontally or along the curves) rather than letters, numbers, or other devices requiring a key. Occasionally, however, keys must be used because a graph contains many curves or the labels are too complicated. If a key is used, it should be placed within the grid in an isolated position, but should not be boxed or enclosed with a border.



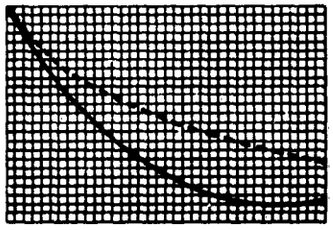
Easy To Read



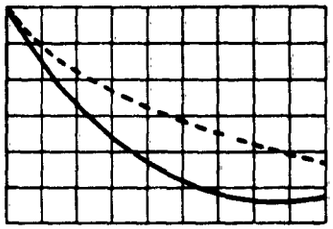
Hard To Read

The number of curves that can be shown on a single graph depends upon their relationship.

FIG. 27. Sample Good and Bad Graphs



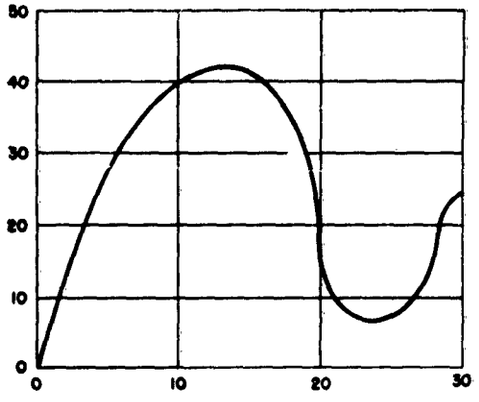
Hard



Easy

Properly spaced grid lines make a graph easy to read.

Hard



Easy

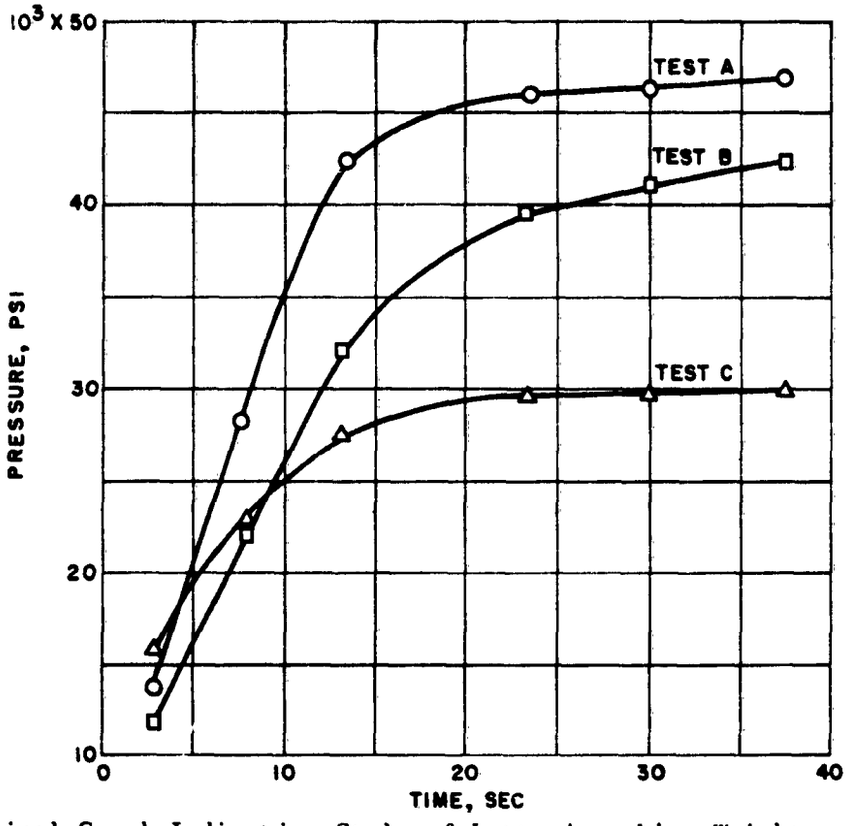
Scales should be selected so that significance of curves will immediately be apparent.

ILLUSTRATIONS: GRAPHS (Contd.)

To the Draftsman. Graphs accompanying manuscripts need not be in finished form for publication (pencil work and photographic copies of originals are acceptable), but all details must be complete and clear. Lettering need not be inked, since normally it will be set in type. If, however, graphs are submitted on which the lettering has been inked according to the style in use at NOTS (see Fig. 28), they may be published without alteration to save time. The suggestions that follow apply to the finished graph.

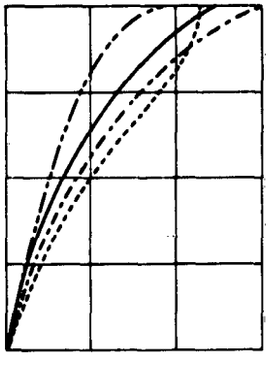
All lettering and numbers should be placed so that they may be read from the bottom of the graph or, in the case of turned labels or captions to vertical scales, from the right-hand side of the graph. Standard abbreviations should be used as much as possible (see Abbreviations), as for example, in denoting the unit of measurement in scale captions. The range of scales should be chosen to ensure effective and efficient use of the coordinate area (see Fig. 27). Ordinarily, enough white space should be allowed around the curves to give an attractive appearance, but to take up space with grid lines beyond those necessary to enclose the curves is wasteful and results in unnecessary reduction of the curves. It is necessary to include the zero line only if visual comparison of plotted magnitudes is desired.

Close coordinate rulings are required only if it is intended that very accurate readings will be taken from the graph; otherwise it is preferable to keep the number of rulings to a minimum so that they will not compete with the curves. Short scale markers or *ticks* may be inserted to indicate the location of scale values between rulings (see Fig. 28). This device is particularly useful where nonarithmetic scales are used.

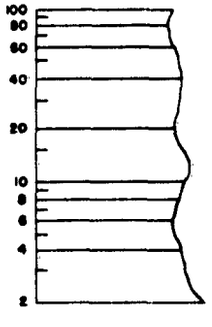


Typical Graph Indicating Style of Lettering, Line Weight, Method of Labeling Curves, Scale Captions, and Use of Symbols.

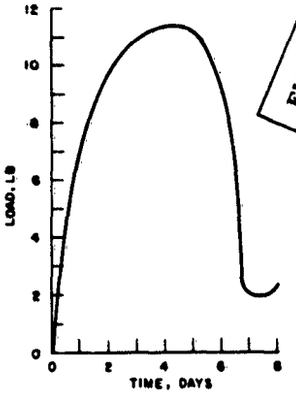
FIG. 28. Sample Treatment of Coordinates



Differentiation of Curves by Use of Various Types of Lines.



Intermediate Values of Logarithmic Scale Shown by Ticks.



Graph With Scale Values Indicated by Ticks Only.

ILLUSTRATIONS: GRAPHS (Contd.)

To the Draftsman. The horizontal (independent variable) scale values should usually increase from left to right, and the vertical (dependent variable) scale values from bottom to top. Scale-values and scale captions should be placed outside the grid area, normally at the bottom for the horizontal scale and at the left side for the vertical scale. If there are two or more vertical scales, it is usually advisable to place one of them along the right side of the grid. For arithmetic scales, the scale numbers shown on the graph and the space between coordinate rulings should preferably correspond to 1, 2, or 5 units of measurement multiplied or divided by 10, 100, etc. The use of many digits in scale numbers should be avoided, either by employing a power of ten as a factor in the scale values (see Fig. 28), or by using a clearly worded designation of the unit in the scale caption, such as RESISTANCE, THOUSANDS OF OHMS (not RESISTANCE, OHMS $\times 10^3$).

The scale caption should indicate both the variable measured and the unit of measurement (separated by a comma), as for example, EXPOSURE TIME, DAYS or PRESSURE, PSI.

Curve designations should be kept within the vertical and horizontal limits of the curves rather than be extended beyond the ends of the curves. Where necessary, arrows may be drawn to connect the labels and the curves. Arrows should be straight, short, parallel to one another, and inclined so that they will be clearly distinguishable from the curves; they should be of the same weight as the grid lines to contrast with the curves.

Line weights suitable for use in illustrations in NOTS reports are indicated in Fig. 29. The sizes of the pens given are those used in preparing the original, which was reduced approximately 2 to 1. If you anticipate some other reduction, select pen sizes that will result in similar line weights.

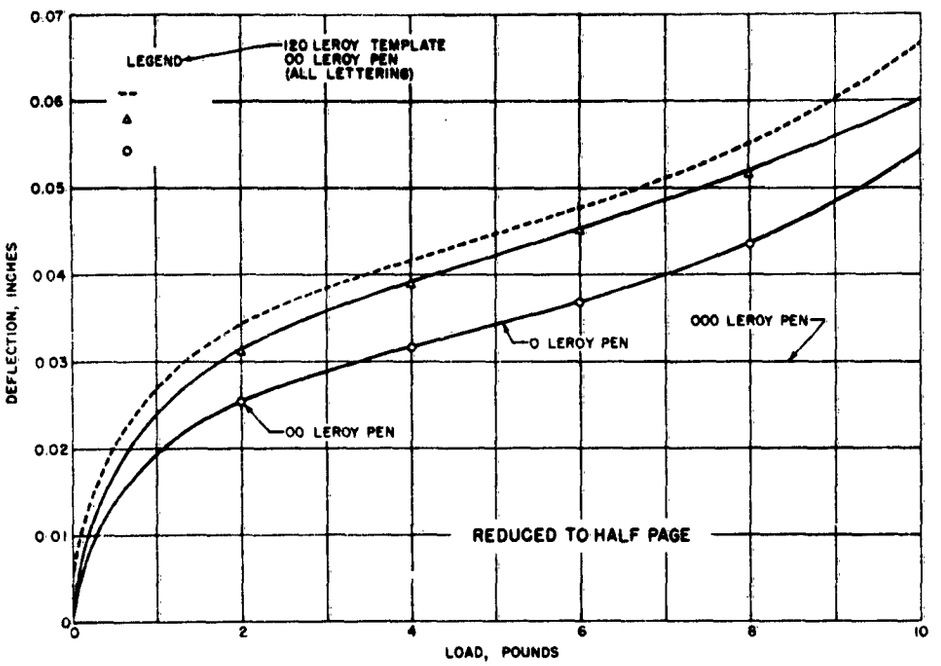


FIG. 29. Guide for Line Weights in Charts and Graphs

USE OF FORMAL TABLES

To the Author. A tabular arrangement is frequently the most economical and satisfactory method of presenting detailed technical information. It can be a very effective means of showing significant multiple relationships otherwise difficult to express. But a table must be so logical in design and so unencumbered by extraneous details that the reader will immediately understand the relationships you intend to convey, or it fails in its basic purpose.

When planning your report, give special attention to the tables. Avoid the mistake of preparing tables that are obscurely complex or include too many kinds of information; several simpler tables are usually better. Remember that the reader is pressed for time and reluctant to puzzle out your meaning. A table that is merely long can be printed on successive pages without difficulty, but a table that is oversize in two dimensions gives trouble to everyone. An oversize table must either be reduced photographically to page dimensions, and perhaps require a magnifying glass to read, or be placed on a page that is folded out. But a foldout, although occasionally unavoidable, is hard to print, difficult to bind, easily damaged, and in any event limited to the size of the equipment—with our cameras and presses, to approximately twice the normal page. Also, such a page forces the reader to lay the book on a flat surface; the table is hard to follow with the eye alone; and it is awkward to reference from a later page in the text, since the back of the foldout is then up. To a lesser degree, even a table of such size that it must be printed broadside instead of normal on the page is an inconvenience, forcing the reader to turn the book.

Too many tables placed with the text disrupt continuity, especially if they are long. Therefore, be discriminate and economical by excluding details that are not pertinent to the report. Nevertheless, bulky tables are sometimes unavoidable. When they are the meat of the report, they naturally belong in the body; but you should then arrange your text so that short paragraphs will not be isolated by the tables. Whenever feasible, however, group them in an appendix or series of appendixes.

Most tabular matter should be prepared as formal tables: that is, captioned with an identifying number and title, referenced in the text by this number, composed separately so as to be as complete and legible as possible on one or more pages, set off from the text by the use of rules, then (in publication) interleaved or cut into the printed text at the most convenient point permitted by layout considerations without destroying the unity of the table. (Under certain conditions, you may find an informal or text table more appropriate. See the discussion under "Use of Text Tables.")

Number your formal tables consecutively throughout the report, using Arabic numerals. Continue the series through the appendixes, except (a) when an appendix is nothing but a table and hence its designation serves in place of table number and title, and (b) when an appendix consists of quoted or reprint matter in which the original numbering of tables must be retained. In the text, reference the tables as *Table 1*, *Tables 2–4*; or, in such special cases as those just noted, as *Appendix A* and *Table __ of Appendix B*, for example. Every table should be accounted for in the text, either by specific reference to the table by number or by a general reference, such as to the appendix in which it appears.

In the title, name the contents precisely and state or imply the purpose, so that the reader may know what he is expected to find. Use a headnote (a note set between title and table) to supply information, qualifications, and values that apply to the table as a whole. Use footnotes to give information relating to specific portions of the table or to individual entries. By the skillful use of these and other devices, you can avoid wordy column headings, diffuse entries, columns of identical values, and other unnecessary complexities that make a table hard to use.

These suggestions are necessarily brief and incomplete. There are, however, more tricks and pitfalls to the presentation of tabular matter than to almost any other phase of technical reporting. Consult an editor in advance when you have a problem with tables, especially if you are planning to use tabulations from an IBM calculator. You will save both yourself and the editor many a headache. Sample patterns of formal tables are given in Fig. 30 in typewritten form.

To the Typist. Prepare each formal table on its own sheet or set of sheets, separate from the text. For a long table of normal width, use as many standard sheets as needed, numbering the sheets and repeating table number and column headings on each page, but not the title. Use oversize paper for wide tables. Identify each sheet in the upper right-hand margin with the manuscript number; mark with the security classification at top and bottom.

In the caption, set *TABLE* in capitals and follow with Arabic serial number and a period. Use title capitalization for the title but no period at the end. Arrange the caption as one line centered over the table, or on two or more lines in an inverted pyramid not wider than the table. Single-space the caption itself, but double-space between the caption and the headnote, or between the caption and the table when there is no headnote. (See Tables 1–6 of Fig. 30.)

Center a short headnote on one line under the caption, but type a long headnote as a paragraph (compare Tables 1 and 2).

TABLE 1. Simple Leader Work

Centered one-line headnote.

First stub entry, units of measure	10,000
Second stub entry, psi	1,945
General stub entry introducing others:	
First subentry, ft	19 1/8
Second subentry, cu in.	24.3
Last entry in stub, fps	12.000

TABLE 2. Simple Leader Work With Column Heads

Headnote exceeding one line should be typed as a paragraph to width of table.

Heading for stub column	Column head, %
First stub entry	10,000.2
Second stub entry of extended length to illustrate turnover line[a]	9,977.3
General stub entry introducing others:	
First subentry	432.0
Second subentry	11,273.7
Last entry in stub	22.0

NOTE: A general note precedes referenced notes.

[a] Turnover is indented four spaces to clear subentries, which are indented two spaces.

TABLE 3. Simple Table With Long Remarks Column

Water, wt. %	Type of reaction
0.75	Violent explosion; container shattered
2.0	Moderate explosion; no damage
2.5	Rapid burning without smoke; brilliant light but no sound
3.0	Rapid burning but light practically obscured by smoke

FIG. 30 Samples of Formal Tables

TABLE 4. Two-Column Table Folded To Make a Table of Four-Column Width

Length, cm	Weight, g	Length, cm	Weight, g
20.75	345.72	24.20	390.09
21.92	354.63	25.10	410.01
22.64	361.82	25.85	418.12
23.05	372.14	26.74	429.83
23.98	381.87	27.14	438.60

TABLE 5. Example of Column Headings Under a Spanner

Round[a]	Burning time, sec	Pressure, psi[b]			No. of Tests[d]
		Peak[c]	Final	Average	
Model 1	0.983	1,243	895	1,001	10
Model 2	2.01	985	642	839	6
Model 3	1.04	1,070	1,004	1,209	14
Control	2.20	835	706	797	5

[a] Stubs with entries of approximately even width are aligned on the left and do not take leaders.

[b] Assign footnote reference indexes from left to right by rows, considering the entire box head as one row. When a spanner occurs, assign first to spanner then to column heads under spanner before moving to next column head.

[c] Use commas after thousands normally.

[d] Use abbreviations but avoid obscurity.

FIG. 30 (Contd.) Samples of Formal Tables

TABLE 6. Compound Table Illustrating a Variety of Stub and Column Entries

Columns illustrate problems of vertical alignment of entries; rows, problems of stub entries and overrun lines.

Stub heading[a]	Turned head[b]	Alignment on decimal point	Whole numbers and fractions	Ranges and word entries
A. Classified Stub With Subentries				
Master entry on more than one line:				
First subentry.....	1	0	21 1/2	15-17
Second subentry.....	3	12.42	1 16/64	6
Third subentry.....	5	1.001	20 3/4	25
Another master entry on two lines:				
Subentry on two or more lines.....	4	13.1	1 13/32	376
Short subentry.....	7	0.73	99 19/64	failure[c]
One-line master entry:				
Subentry.....	9	40.2	63/64	140-180
Subentry.....	10	142.433	8 11/16	76
B. Stub Entries Governing Multiple Rows				
Stub entry of two or more lines governing several rows of data	11	0.027	10 1/4	8-10
	9	0.042	9 3/4	3-5
	0	0.019	(d)	4-6
Short stub entry.....	8	20.004	17 1/2	978
	7	20.192	16 3/4	897
	6	18.971	16 1/4	880
Another long entry that governs three rows	12	210.3	.....	7.1-8.2
	..	199.6	.....	6.9-7.4
	..	208.1	.....	7.0-7.5
Short entry.....	6	76.9	9	85
Total[e].....	14	457.893	10 1/16	983

[a] Overrun lines in first-order entries are indented twice the indention of subentries whenever subentries occur.

[b] To be avoided if possible.

[c] Short word entries. Columns of long word entries are aligned on the left, with first word capitalized and overrun lines indented.

[d] Method of footnoting an omission. Omissions not footnoted are shown by leaders (periods) the width of the normal entry in the column.

[e] Or average.

FIG. 30 (Contd.) Samples of Formal Tables

Either phrase or sentence structure is acceptable, but use sentence capitalization and punctuation. Place the headnote closer to the top of the table than to the caption.

Column headings are required above each column, including the stub, to identify the entries—except in the type of leader work that is simply a listing of miscellaneous items (Table 1). In the majority of tables, each horizontal row also carries the equivalent of a heading to define the row. These row or line "headings," which are arranged in a column at the left, are called stub entries, and the column is known as the stub. In a formal table, the stub itself should have a descriptive column heading, if only the word *Item*.

Units of measure frequently occur either in the column headings (Tables 2–5) or in the stub entries (Table 1), depending upon the type of table, but never in both, or the result is a contradiction. These units should normally come at the end of the heading or stub entry, separated from the preceding descriptive matter by means of a comma.

In column headings and stub entries, capitalize first words and proper nouns only. Use standard abbreviations freely to conserve space, irrespective of whether or not they are used in the text; but not to the point of obscurity.

In columns of lengthy word entries, such as remarks, capitalize first words and proper nouns, but do not use final periods (Table 3) unless the entries are unavoidably in the form of complete sentences. Do not capitalize incidental short word entries in number columns (Table 6) unless they are proper nouns, or unless they occur in tables which also have columns of word entries with initial capitals. In the latter case, uniformity in the use of capitals is desirable.

Center column headings above their columns. If it is necessary to arrange some of them vertically, be sure they read upward from the table.

Align the word entries of the usual stub column on the left and follow each entry with leaders (rows of periods without spacing) that are aligned on the right to fill out the column evenly. When the stub contains classifying entries and subentries, indent the subentries two spaces and use leaders only after these. Omit leaders from the entire stub when all entries are short and of even length, and no subentries are involved (Table 5). Also, do not use leaders when all entries are numbers (Tables 3 and 4).

When a stub entry requires more than one line, indent the runover portion two spaces, but when there are subentries in the stub, indent the runover four spaces to clear the subentries (Tables 2 and 6). In the special case where a stub entry requiring two or more lines also governs two or more rows of values in

the columns that follow, the top row of values may be aligned with the first line of the stub entry to save vertical space, but leaders must not be used after that particular stub entry since they would not lead to the first value (Part B of Table 6).

Similarly, align on the left in columns of lengthy word entries (remarks, for example) and indent runover lines two spaces (Table 3). The principles of alignment in other types of columns are summarized below, although the discussion is by no means complete.

In columns of numbers that are similar in nature (all values represent pounds, inches, or the like), align as follows: (a) whole numbers only, on the right; (b) whole numbers and decimal fractions, on the decimal point, whether expressed or implied; (c) whole numbers and common fractions, on the right by the whole numbers, with fractions following after a single space. But center in the column such incidental word entries and ranges of numbers as occur. The most common alignments are illustrated in Table 6.

In the type of leader work, however, where each horizontal line represents a row of similar items and the column entries are consequently dissimilar (pounds in one row, inches in the next, for example), align on the right (Table 1). Occasionally, the entries are such that centering or alignment on the left looks better.

Do not space or attempt to align plus, minus, and plus-and-minus signs used before number entries in columns to indicate the sign of the quantity; set them tight. The plus-and-minus sign used between two numbers to indicate tolerance should normally be spaced, but may be set uniformly tight in a crowded table.

Use commas with thousands as well as tens of thousands, except in serial numbers (such as house, telephone, year, page) and temperatures. (The commas may be omitted consistently, however, in the occasional crowded table where no tens of thousands occur and the space required by the commas would force the turning of the table on the page or the use of a foldout. But leave this decision to the publisher's editor.)

Zeros before decimal points are standard, except in expressing caliber, but may sometimes be "understood" when there is no danger that a number may simply have dropped out in printing. In columns having some entries with numbers to the left of the decimal point and some without, insert a zero to the left of each point where there is no number. In columns of at least five entries, all of which are decimal fractions, zeros may be omitted before decimal points except in the first and last entries. When all values in a table are decimal fractions and are so understood immediately by the reader because of the nature of the table, zeros may be omitted before all the decimal points.

Never add zeros to the right of the decimal point to even out the column. Such zeros have technical significance.

Never leave blanks in columns; instead, indicate an omission in a positive manner by inserting leaders (a row of periods) where the entry would be. If the omission is explained in a footnote, insert the reference index in parentheses in place of the leaders. (See Table 6.)

Do not use ditto marks (") in tables; they may drop out in our method of printing. Instead, repeat a short entry as many times as necessary. Use the abbreviation "do." instead of repeating a long word entry; but never use it (a) in a stub, (b) to represent only a portion of the preceding entry, or (c) to represent a preceding entry without its footnote. Center "do." in a column in which entries are centered, or align if they are aligned. Capitalize only if the entry it replaces begins with an initial capital.

Horizontal rules are used above and below the body of each formal table, below column headings, and between "spanners" (headings that extend over two or more columns) and the column headings they span. Other horizontal rules are used occasionally in tables that have internal subdivisions, principally above and below centered subtitles identifying the parts.

Vertical rules will appear between columns in most of the printed tables, but not at the sides. Narrow tables are sometimes doubled or "folded" to save space or to improve the appearance of the printed page. Double vertical rules are used between the portions of folded tables that are set side by side (Table 4). These need not be shown in the manuscript as submitted for publication except where they are necessary for clarity, but plenty of space should be left between columns.

Use vertical "group spacing" instead of horizontal rules whenever practical (a) to increase the legibility of tables that would otherwise be too solid to read without a straightedge, and (b) to set off multiple rows of column entries governed by single stub entries whenever they might otherwise be confused. The latter situation most commonly arises when the single stub entry runs to more than one line. The extra space should be full typewriter line space in the manuscript, but may be less in the printed table.

Place footnotes to formal tables immediately below the table on the same sheet; do not list with the footnotes to the text. Use superior (raised) lower-case letters as reference indexes to key the notes to the table. (These will be in italic when printed, but do not attempt to underscore in the manuscript.) Assign them across the table from left to right by rows (not down the columns) (Tables 5 and 6). Do not use numbers for reference indexes in formal tables (they are reserved for text), and use the series of

symbols beginning with the asterisk (*) only when necessary in order to avoid confusion with mathematical symbols, or as a classifying device to set off special categories of entries.

Normally, arrange footnotes as separate paragraphs the width of the table. Type the reference index (raised) at paragraph indention, space once, then begin the note itself with first word capitalized, unless the first character is a lower-case symbol. The footnote need not be a sentence, but it ends with a period. Two short footnotes may be placed on one line, with at least 5 spaces between them. A long series of short notes may be arranged in columns. Do not space vertically between footnotes.

A general note that is not a headnote (a rare occurrence) precedes the keyed footnotes. Type it in paragraph style and start the first word at paragraph indention—that is, where the reference index goes in a keyed footnote (see Table 2). On the other hand, type a second paragraph to a keyed footnote so that the first word starts under the first word of the preceding paragraph. Footnotes keyed with symbols precede those keyed with superior letters, if both occur.

USE OF TEXT TABLES

To the Author. When you wish to introduce simple tabular matter directly into your discussion, the informal or text table illustrated in Fig. 31 is the device to use. This is in effect a form of displayed text in which interdependent items of information are arranged in columns so that your reader can grasp their relationships more readily. The arrangement of the columns is similar to that in a formal table, but the intimacy with the text is maintained by the omission of table number, title, and rules.

Because a text table is part of the text, it must be reproduced in the printed report at the exact place it is introduced. Remember, however, that the printer may have to break such a table at the bottom of a page and continue it on the next page if it happens to fall that way. For this reason, do not use a text table except when your tabular matter (a) is an integral part of the discussion; (b) is very brief or is essentially a mere listing that can be broken at any point the page may happen to end; (c) consists of only two or three columns; (d) uses only the simplest of column headings; and (e) is free from lengthy remarks and other complexities. Otherwise, convert to a formal table.

A text table carries no number or title, but is introduced directly by the preceding text. Column headings are not required over the stub or with leader work that is intelligible in context without them. Headnote information is written into the text. Footnotes are to be avoided as part of the tabular display, but are permitted as normal footnotes to the text and numbered in the same series.

To the Typist. Insert a text table into the manuscript at its proper place in the text—that is, on the same sheet, immediately following the introductory words, or on a following sheet marked for insertion at this point. Do not number a text table or place it with the formal tables, which are grouped and handled separately from the text.

Column headings will be set in italics for printing, but do not underscore them in the typewritten manuscript. The editor will mark them for the printer. When a spanner is used over two or more column heads, however, insert an underscore line between the spanner and the column heads to the width of the columns that are spanned. This will appear as a horizontal rule in the printed table, and is the only kind of rule we use with text tables.

Column headings may be on more than one line if necessary, but align them along the bottom. Never turn them to read vertically. Center them over the columns.

Capitalization, punctuation, alignment, the handling of runover lines, the use of zeros before and after decimal points, the

indication of omissions in columns, and the handling of repeated entries are the same for text tables as for formal tables (see "Use of Formal Tables").

Footnotes to text tables are, with rare exceptions, numbered in the same series and treated in the same manner as footnotes to the rest of the text (because text tables are merely displayed text). List them with the footnotes to the text.

This page illustrates text tables cut into a page of manuscript. Here is a simple table with leaders:

Body.....	Model A-3
Over-all length, in.	28 1/2
Weight, fully loaded, lb	250
Pressure at nozzle, psi:	
Average	1,500
Maximum	2,500
Duration of burning, sec	25.3

Note placement of the units of measure and alignment of the column of dissimilar entries.

Headings, when used, should not be underscored in manuscript. They may be more than one line in depth and should be aligned at the bottom, as in this example:

FIG. 31 Samples of Text Tables

Source	Wt. of sample, g	Water, wt. %
A	3.5792	25.92
B	2.1721	23.86
C	2.7293	21.73

A spanning head requires a tie bar long enough to cover the full width of the columns spanned:

	Pressure, psi	
	Front	Nozzle
Round 1	1,262	1,120
Round 2 (control) ...	1,884	997

Warning: Avoid placing text tables close together in manuscript, particularly if they have column headings. The printer may have to end a page in the middle of a table.

Part 3

TRANSMITTAL OF MANUSCRIPTS TO TECHNICAL PUBLISHING DIVISION

PROCEDURES

Identification Series. The formal technical reports of the Naval Ordnance Test Station are issued as reports of the NAVORD series established by the Bureau of Ordnance. Technical publications of all types issued officially by the Station carry a number from the NOTS series recorded by the Technical Publishing Division.

Approval of Manuscripts. Of the three classes of technical reports defined in Station Order 10-51, only the first and second are considered formal reports. Class 1 comprises the reports issued under the direct authority of the Technical Director; Class 2, the extensive group issued under authority delegated to the heads of the technical departments. The manuscript of each Class 2 report is approved by the head of the cognizant department, after it has been reviewed for technical adequacy by the two or more persons he has designated, and then forwarded to TPD.

Transmittal Memorandum. Department heads are requested to use the revised form memorandum (Fig. 32) when forwarding manuscripts of Class 2 technical reports for publication. A similar memorandum should be used to transmit other types of publications. The transmittal memorandum should provide (a) full identification of the manuscript, including title, author(s), security classification, and pertinent task assignment; (b) authorization to publish; (c) instructions regarding distribution; (d) identification of reports (including Class 3) superseded; and (e) a statement that technical reviewing has been accomplished and the reviewers have been named in the foreword. The letter of transmittal must carry the same classification as the report.

Distribution. Basic distribution should be indicated on the transmittal memorandum by identifying the standard lists to be followed, when these are applicable. Additional distribution should be requested by giving full instructions on a sheet attached to the memorandum and noted therein. Whenever subsequent distribution of more than 25 copies is anticipated, a note to this effect, together with an estimate of the number of copies, should be included.

Delivery. Delivery of the manuscript and two copies of the transmittal memorandum should be made to the nearest office

_____
Classification

U. S. NAVAL ORDNANCE TEST STATION, INYOKERN
China Lake, California

_____
Date

MEMORANDUM

From: Head, _____Department, Code _____
To: Head, Editorial Branch, Code 5561

Subj: Publication of _____/MS-_____

Title: _____

_____

Author(s): _____

Classification: _____ Task Assignment _____

1. The subject manuscript has been approved and is forwarded herewith for final editing and publication as a Class 2 technical report (NAVORD series). The following distribution is desired:

a. Off-Station. Standard List(s) _____

Additional copies to _____

b. On-Station. Standard, with additional copies to

_____

2. This report supersedes the following Class 3 report(s):

_____

3. The manuscript has been reviewed for technical accuracy by two or more competent persons, who are named in the foreword, as requested by the Technical Director.

_____

In duplicate
Copy to:

Head, _____

FIG. 32. Sample Transmittal Memorandum for Class 2 Reports

_____
Classification

of the Editorial Branch (Code 5561 at Inyokern or Code P5561-1 at Pasadena).

Publication Date. The forwarding memorandum should be dated when it is signed by the department head, since this date becomes the publication date of the printed report.

SECRET Reports. When SECRET reports are transmitted for publication, the transmittal memorandum must show the document number assigned to the manuscript.

MANUSCRIPT REQUIREMENTS

Acceptance of Manuscript. A manuscript submitted for publication must be complete in all respects at the time of transmittal. Detailed instructions on the preparation of the individual portions of the report are discussed under the appropriate sections of Part 2 of this handbook, to which the author is referred for advice on specific problems. Additional copy submitted after a manuscript has been received by TPD will not be accepted, except under special circumstances. A manuscript is reviewed by the Editorial Branch upon receipt and may be returned at that time if it is not complete in all features or if the quality is found unacceptable.

Copy. In all cases, the material that is transmitted for publication consists of (1) manuscript, (2) the original or one print of each figure to be reproduced as a line drawing or graph, (3) two prints of each figure to be reproduced as a halftone, (4) separate copy for footnotes to the text, (5) separate copy for figure legends, and (6) separate copy for all numbered tables. For Class 2 reports, the manuscript must include at least a title page, a foreword, an abstract, and the body of the report.

Identification of Superseded Reports. The publisher's statement in each Class 2 report provides for identification of Class 3 reports (technical memorandums) it supersedes. It is the reaponsibility of the issuing department to make this information available to the Technical Publishing Division at the time a manuscript is forwarded to TPD. If the material being published also supersedes previous NAVORD reports or is a continuation of the work reported in a previously issued NAVORD report, this fact must be noted in the foreword.

Foreword of Class 2 Reports. In accordance with the instructions of the Technical Director, each Class 2 report carries a foreword over the name of the department head who has authorized publication. It is also a requirement that this

foreword include the names of the technical reviewers. The department head, therefore, should make certain that the foreword does in fact give all the desired information from his point of view.

Figures From Earlier Reports. Figures published in one report are occasionally resubmitted for publication in another. In order to save duplication of labor, authors and departmental editors are urged to call them to the attention of TPD when a manuscript is submitted for publication. If the figure is a halftone, the earlier reproduction art should accompany the manuscript if it is available. (When a report is off the press, all repro art that has been worked up for halftone illustrations is returned to the cognizant department or the author, as the department desires.)

AUTHOR'S REVIEW

The author, or his designated alternate, is given an opportunity to review the edited manuscript before it is forwarded to the Publications Branch for composition. At that time he may resolve any troublesome details as well as any special problems that are foreseen by the editor. If major questions or revisions are involved, he may take back the manuscript for reworking.

The author is also required to review the reproduction copy (in lieu of page proof) after it has been checked by the editor and just prior to forwarding it to the Printing and Reproduction Branch for printing. Authors should keep in mind that any changes made in the repro copy are costly and time consuming, invariably resulting in delay in the release of the report. Every effort should be made, therefore, to make certain that the edited manuscript is correct in every detail before it is forwarded to the Publications Branch for composition.

Part 4
MATTERS OF STYLE

CAPITALIZATION

Many of the rules of capitalization have been firmly established through years of usage and are followed unconsciously by all authors. Therefore, no attempt will be made in this section to cover the entire subject; instead, you will find below a few basic rules covering those parts of the capitalization problem that experience has shown are most frequently misunderstood by the average NOTS author. In the interest of consistency within and among the reports published at NOTS, these rules are set forth here as they are generally accepted by the leading publishers and authorities in the field today and as they are used by TPD.

Common Nouns. A common noun is capitalized when it is an integral part of a proper name, but is normally not capitalized when used alone. For example:

Blandy Street; *but,* the street
Kern County; *but,* the county
Station Theater; *but,* the theater
Angeles National Forest; *but,* the national forest

When a common noun is a well-known shortened form of a specific proper name that is important in the context, and may therefore be considered restrictive, it is capitalized. For example:

Michelson Laboratory; *and,* the Laboratory
Naval Ordnance Test Station; *and,* the Station
Rockets and Explosives Department; *and,* the Department
Bureau of Ordnance; *and,* the Bureau

A common noun, or its abbreviation, is capitalized when it is used with a specific number or letter for the purpose of referencing an item identified in a series by that number or letter. For example:

Table 6	Round 4	Panel 14
Fig. 1	Test 12	Section A
Ref. 3-5	Group 2	Appendix B

Do not, however, capitalize such a noun when it is used only incidentally to reference items actually unnumbered or numbered in an unimportant series. For example:

column 2	paragraph 6
page 354	subparagraph 3

Names of Government Organizations. The names *Army, Navy,* and *Air Force* are capitalized when used as nouns or adjectives either as part of the name of an organization or when standing alone but referring to these branches of the United States military forces. The adjective *naval,* however, is not capitalized unless it is part of a proper name. For example:

the Navy plans to . . .
the U. S. Naval Ordnance Test Station; *but,* the naval maneuvers . . .
cooperation between the Army and the Navy has led to . . .

The names of units of government agencies and the like are capitalized, as are the accepted short forms of these names. For example:

the Test Department
NOTS
the Editorial Branch; *but,* the various branches of the . . .
Navy Electronics Laboratory
BuOrd, BuAer, BuShips

Names of Geographic Regions. A term that denotes a specific geographic region is capitalized, but the same term is not capitalized when it is used in its general sense. For example:

the East; *but,* the highway leads east from the Station . . .
the Pacific Northwest; *but,* the northwestern part of the nation . . .
the Lake States; *but,* the states bordering the Great Lakes . . .
the South; *but,* southern Nevada

Trade Names. Trade names and names of brands are capitalized. However, common nouns following, but not an integral part of, such names are not capitalized. For example:

Chromel-Alumel thermocouples
Vickers hardness tester
Bakelite
Barton flow recorder
Universal testing machine

Many words that at one time were capitalized as trade names have now become a part of the language. These words are not capitalized. When in doubt about the capitalization of such words, consult *Webster's* and use the lower-case form when permitted. Examples of such words are:

venturi meter
macadam
linotype

but, Wheatstone bridge
Erlenmeyer flask

Official Names of Weapons or Parts of Weapons. The official names of weapons or parts of weapons, in the form accepted by the Bureau of Ordnance or other cognizant agency, are capitalized. Abbreviated forms of these names are likewise capitalized. For example:

the 0.00 High-Performance Rocket Mk 0 Mod 0
the 0.00 HPR Mk 0 Mod 0
the Fuze EX-000
but, the 0.00-inch rocket
the fuze

The names of proposed weapons that have been accepted by the Station for use during the development period are capitalized. For example:

Demolition Charge NOTS Model 000
but, the demolition charge

Series Preceded by a Colon. When a series within a paragraph is introduced by a statement ending with a colon, the first word after the colon is not capitalized unless it begins a complete passage or sentence. For example:

The report contains two kinds of information: (1) the results of work in research performed at this station; and (2) the results of work in the same field performed by other organizations.

The diagram illustrates the three equilibrium curves: solid-liquid, liquid-vapor, and solid-vapor.

The project was begun with the promise that two things could be accomplished: (1) Sufficient funds would be made available to hire an adequate staff. (2) The work would be allowed to proceed uninterrupted for 12 months.

Note, however, that the last example could have been written as two independent clauses (rather than sentences) following the introductory statements, thus:

The project was begun with the promise that two things could be accomplished: (1) sufficient funds would be made available to hire an adequate staff, and (2) the work would be allowed to proceed uninterrupted for 12 months.

Displayed Text. The first word of each of a numbered or lettered series of items set off in typographical display from the preceding text is capitalized. For example:

Several types of courses are described, including the following:

1. Normal pursuit
2. Line-of-sight course
3. Constant-bearing course
4. Constant navigation
5. Proportional navigation

When definitions of mathematical symbols are displayed typographically in the text, with equals signs between symbols and definitions, the first words of the definitions are not capitalized. For example:

The variables and important constants being used are:

L_N = first centripetal load factor
L_T = second centripetal load factor
R_N = first radius of curvature
R_T = second radius of curvature
V = speed

In formal tabulations of nomenclature, however, the equals signs are omitted and the first words of the definitions capitalized (see *Nomenclature*).

Titles, Headings, and Legends. The titles of formal tables, certain section headings, and the title portion of figure legends are distinguished by the use of a style known as *title capitalization*. It is the basic style for the titles of books, journals, and other publications, as well as parts, chapters, and sections thereof, and is normally used except where the typography is all capitals.

In this style as applied at NOTS, all first words are given initial capitals and also all other words and abbreviations regardless of position or hyphenation, except the following:

a. Particles of three letters or less. That is, in effect, the articles *a, an, the*; the prepositions *at, by, for, in, of, on, per, to, up*; and the conjunctions *and, as, but, if, or*. (But *to* as the sign of the infinitive is capitalized, as in *To Be, To Perform*; likewise, any of the others when used as different parts of speech.)
b. The second element of a compound number that is written out, such as *Twenty-three, Thirty-second, Two-fifths*.

c. Abbreviations of technical units of measure. (Where distinctive capitalization already appears in such abbreviations, it is retained, as in *Btu*, *°C*, *Mc*. Spelled-out units are treated as ordinary words.)
d. Letter symbols, chemical symbols, signs, and operators. (These do not change in capitalization or basic style of type—roman, italic, boldface, etc.—no matter where they appear.)

The following are some examples:

Titles:

Gas Composition With and Without Corrections for Gas Imperfections Under Typical Conditions

TABLE 4. Examples of Specific Impulse as Computed by the Complete Equilibrium Method

Headings:

First Approximation Theory of the Nonlinear Case

Derivation of the von Kármán Momentum Integral Equation

Legends:

FIG. 1. Temperature and Velocity in the Turbulent Boundary Layer.

FIG. 18. Exploded View of CZR-1 Shutter Motor Showing Pip Magnet Set in Brass Wheel.

When hyphenated compounds are used in titles, headings, or legends, all parts are capitalized except particles (articles, conjunctions, and prepositions) of less than three letters. For example:

High-Performance	Steady-State
Air-to-Air	Series-Connected
Ribbon-Frame	20-Microsecond
Three-Axis	Shaped-Charge

Official Titles. The official titles of high-ranking administrators of government and other agencies are capitalized when used with the name or as a substitute for it. For example:

Frederick W. Brown, Technical Director; *or*, the Director
John H. Shenk, Head, Research Department; *or*, the Department Head
the Secretary of the Navy

NUMERALS

Since the majority of the reports published at NOTS are highly technical in content, the free use of Arabic numerals (figures) is not only permissible but desirable. With the exception of approximate numbers, isolated small numbers occurring in nonstatistical context, and numbers that start sentences, numerals should be used; but variations from this style are sometimes made for the purpose of improving the readability and the typographic appearance of the reports. The following rules, although they do not cover all situations, indicate the style followed by TPD.

Measurements. Any measurement followed by the unit of measurement is expressed in numerals. For example:

2 pounds	1 inch
6 miles	1.7×10^{-4} g/cc
2- by 4-inch timber	5.1 cm
1½ tons	2,150,000 dynes/cm^2
20 cubic yards	1,876 psi

Two or More Series of Numbers. When two or more series of numbers are closely associated in one sentence, numerals are used for only one series, preferably the one representing measurements. For example:

. . . including six 2-gram, eight 4-gram, and sixteen 6-gram samples.

. . . shown by a standard deviation obtained from six values, of about 15 parts per 1,000.

. . . all twenty-four tests were completed in less than 2 hours.

Percentage. Percentages are expressed in numerals. For example:

16 percent	1.42 percent
2 percent	0.50 percent

Ratio. Ratios are expressed in numerals. For example:

2 to 1 15:50 4/1

Temperature. Measurements of temperature are expressed in numerals. (The degree sign, followed immediately by the abbreviation of the scale, is always used with temperature measurements instead of the word *degree*. When more than one

measurement is given, the sign and abbreviation are used with the last figure only.) For example:

26°F	10 to 12°K
0.45°C	60, 80, and 120°F

Angular Measurement. Angular measurements are given in numerals. (When the measurement is in degrees only, the word *degree* or its abbreviation is used, the simple degree sign being reserved for measurements of temperature. To avoid awkwardness, however, signs are used instead of the abbreviations when the measurement is in degrees and minutes, or degrees, minutes, and seconds.) For example:

a dive angle of 30 deg
but, a reading of 12° 27′
an angle of 52° 14′ 36″

Zero Preceding a Decimal Point. Decimal points should normally be preceded by a zero when the quantity is between +1 and −1, except when the measurement is in calibers. For example:

0.75 inch −0.24 gram .22 caliber

Time. All measurements of time, including age, clock time, and dates, are given in numerals. Except when quoted from other publications, time and dates are written in the accepted Navy style. For example:

6 years	from 0730 to 1630
3 months 2 weeks	16 June 1951
about 2½ hours	*but* (when quoted), June 16, 1951

Isolated Numbers. In nonstatistical text, isolated numbers under 10 that are not actual enumerations are written out. Larger numbers are expressed in numerals, unless there are other series of numerals from which these should be distinguished. For example:

at least nine samples should be taken . . .
more than 25 copies of the report . . .

Fractions. Fractions are expressed in numerals when used as part of a unit modifier. For example:

1/2-inch tube 3/4-inch valve 5/32-inch opening

Simple fractions that are not measurements are written out, but mixed numbers are expressed in numerals. For example:

less than one-half of the rounds . . .
a model one-tenth the size of the original . . .
but, it was 2¼ times as large . . .

Mark, Modification, and Model Numbers. The Navy mark and modification numbers and the NOTS model numbers for weapons and parts of weapons are expressed in Arabic numerals. For example:

the 0.00 Aircraft Rocket Mk 0 Mod 0
the Fuze EX-000 Mod 0
the Line Charge NOTS Model 000
the Igniter Mk 000
the Squib NOTS Model 00

Ordinal Numbers. Ordinal numbers are written out. For example:

the second series of tests
the tenth pass was unsatisfactory
after the sixty-third day

Large Numbers. Numbers of four or more digits are expressed in numerals unless they are indefinite. Commas are used in all numbers of more than three digits, with the exception of serial numbers (such as house, telephone, year, and page numbers) and measurements of temperature, which are set without punctuation. For example:

when 1,875 tests had been run . . .
the missile reached a speed of 45,000 fps . . .
the sample was subjected to a temperature of 2500°C . . .
but, fewer than a thousand rounds were fired . . .

Roman Numerals. Except in special circumstances, it is preferable to use Arabic numerals rather than Roman numerals. Experience has shown that Roman numerals are space-consuming and difficult to read. For example, *1938* is simpler than *MCMXXXVIII*. Similarly, *Eq. 18* is easier to read than *Eq. XVIII*.

Numbers With Serial Designations. Numbers used in serial designations are expressed as numerals, regardless of their size. For example:

Fig. 1 Eq. 22 Table 5

PRINCIPLES OF COMPOUNDING

In technical writing more than any other kind of writing the correct use or non-use of the hyphen in compound words may be of critical importance. With a temporary adjectival compound of the sort known as the "unit modifier," for example, the presence of the hyphen establishes the exact meaning. Consider such a pair of phrases as *dry extruded propellant* and *dry-extruded propellant*. Without the hyphen the natural interpretation is "dry propellant prepared by extrusion" (that is, the propellant is dry although it may have been extruded by the wet process), because the adjective *dry* here governs the complete concept *extruded propellant* that follows. When the hyphen is used, the meaning can only be "propellant extruded when dry" (that is, using the dry process), because in this case the compound expression *dry-extruded* is unmistakably the unit modifier governing the simple concept *propellant*.

Precise use of the hyphen in situations like this one is such a real aid to the technical reader in grasping the intended meaning promptly that a reasonable consistency in hyphenation is worth the effort. Dictionaries do not, unfortunately, always agree as to which of the well-established or so-called "permanent" compounds are in fact written solid, which with a hyphen, and which separate. But choose the most widely recognized dictionary, *Webster's*, as the basic authority and you have quickly solved the first half of the problem: how to "spell" the permanent compounds. Extend to all temporary compounds the principles accepted by that dictionary as the trend of the best usage, and you have solved the second and more troublesome half.

For your convenience, the more important of these principles are summarized below from the point of view of technical writing, together with some guidelines to their application, some specific examples, and some notes on exceptions.

First, there are some general instructions that can be stated in broad terms.

1. **Write solid** only those compounds made up of independent words (*horsepower, switchboard,* to *typewrite*) that have definitely been accepted in this form either into the language generally (see *Webster's*) or by the leading writers and publishers in the technical field.

Hyphenate those that have been accepted in the hyphenated form (*by-product, man-hour,* to *air-dry*). Otherwise, write them separate.

Note especially that a number of these are solid when used as one part of speech and hyphenated or even separate when used as another (see the detailed examples below). The tendency is for nouns to be solid or separate (*blackboard* but *short circuit*); adjectives and adverbs to be hyphenated (*machine-made* part; to strike *head-on*); and verbs to be solid if formed with a prefix (to *underestimate*) but otherwise hyphenated (to *short-circuit*).

2. **Also write solid** most compounds made up of an independent word and a standard prefix, suffix, or other combining form (*semitransparent, finlike, telemetering*) whether they are compounds in general use or you have made them up for the occasion.

Several groups of important exceptions are hyphenated: (a) to set off the prefixes *self-* (reflexive, as in *self-ignition*) and *ex-* (meaning "former"), thus retaining the emphasis; (b) to prevent triple consonants, double vowels, or other confusing sequences of letters (*bell-like, semi-incandescent*); (c) to avoid misreading (*co-worker; re-form,* meaning "form again"); and (d) to maintain the identity of a proper name (*pro-American*).

Note: For the common words *cooperate* and *coordinate* in their various forms, choose the alternate spellings without the hyphen.

3. **Write separate** most other noun compounds that you may form temporarily. Hyphenate only those that are parallel to the relatively few already accepted with a hyphen (*man-second,* parallel to *man-hour*).

4. **Hyphenate** as a normal practice all adjectival compounds that are true unit modifiers, that is, those composed of two or more words not ordinarily a unit but to be taken together as a modifier of the noun that follows ("many such *high-temperature* readings" meaning "readings of high temperatures"). But never hyphenate when the unit idea is not intended ("conditions resulting in *high temperature* readings" meaning "temperature readings that are high").

5. **Hyphenate** temporary verb compounds (for example, to *double-distill*), except those formed with simple prefixes (to *redistill*). But note that regular verb-adverb combinations are two words (to *distill off*).

6. **Hyphenate** prefixes normally written solid (*nontechnical, semiautomatic*) only when you intend unusual emphasis (definitely a *non-technical* matter) or to show contrast (a *semi-automatic* system that is better than the *automatic*).

7. **Do not hyphenate** words in regular sequence and grammatical relationship when there is no possibility of misunderstanding (an *entirely new* method; a process that is *well known;* first *one half* and then the other).

8. **Instead of the hyphen,** use the heavier en dash between elements of a unit modifier when one of them consists of more than one word or is spelled with a hyphen (the *carbon dioxide–water* system; a *2-methyl-2-hexanol–water* mixture; the *sodium–sea water* reaction). Avoid temporary hyphens within the elements unless critical to the meaning.

Note: For an en dash on the typewriter, either roll up the underscore or use a hyphen preceded and followed by a space (2-methyl-2-hexanol - water mixture). Do not use two hyphens set close (--) because they represent the ordinary em dash.

In addition, there are a number of generalizations and exceptions that, when stated in detail, have some value as reminders of the classes of words you may need to verify. The treatment below is more suggestive than exhaustive.

Nouns. Compounds used as nouns are mostly solid or separate. They are usually solid when they have taken on a definite special or figurative meaning; also, when they are made up with a prefix, suffix, or one of the simple words frequently used as a combining form (*board, book, man, work,* and many others). Such solid compounds normally retain only one primary accent. Otherwise, compound nouns are usually separate.

airfoil	gyroscope	air vent
airplane	horsepower	bomb bay
autotransformer	notebook	butt weld
bombsight	retroaction	center line
cardboard	trestlework	cross wind
downspout	watercourse	water vapor

The relatively few compound nouns that require hyphens fall principally into these general classes:

(a) Those formed with a verb plus a noun or pronoun; a verb plus another verb; a verb plus *-er* plus an adverb; or sometimes a verb plus an adverb (many of the simple ones are solid).

cure-all	passer-by	*but* cutoff
know-nothing	hanger-on	feedback
has-been	take-off	setup

(b) Those naming two aspects of a person or concept, including units of measurement of this type, two-word numbers and fractions, and complex points of the compass.

city-state	twenty-one
actor-manager	twenty-first
foot-pound	two-thirds
horsepower-hour	north-northeast

(c) Those made up of several simple words, a noun plus a prepositional phrase, or a possessive case plus a noun.

give-and-take	bull's-eye
man-of-war	mare's-tail

(d) Those consisting of a single descriptive or designating letter plus a noun.

I-beam U-bolt X-ray O-ring y-axis

Note: TPD uses the hyphen in compounds of class (d) whether they are nouns or adjectives in order to retain their identity, thus following GPO rather than *Webster's*.

Adjectives. Compound adjectives are mostly hyphenated, including those that correspond to compound nouns that are separate or hyphenated, and also including nearly all unit modifiers. However, solid compound nouns used as adjectives usually remain solid; and adjectives composed of multiple-word proper nouns remain separate.

air-vent mechanism	high-gain amplifier
cross-wind force	airplane parts
water-vapor data	notebook cover
twenty-one items	downspout angle
bull's-eye hit	China Lake population

Warning: Compound adjectives made up of two or more separate words grammatically related but out of their normal position in the sentence or otherwise ambiguous take hyphens when they immediately precede the noun they modify. However, the same words often do not take hyphens when they are in their normal position or when there can be no ambiguity. (For example, there can be no ambiguity when an adverb ending in *-ly* is used with a present or past participle.) Compare these phrases:

dark-green shadows	shadows that are dark green
a wide-open door	a door that is wide open
a made-to-order item	an item made to order
a two-thirds majority	two thirds of those present
a well-made pattern	a pattern that is well made
	but a carefully made pattern

Verbs. There are compound verbs of three types that show different trends.

(a) Compound verbs formed with prefixes are mostly solid, and so are their participles and the corresponding noun forms.

to overhang: an overhanging or overhung part; an overhang

to understand: an understanding or understood person; an understanding

(b) Compound verbs formed with an adjective plus a noun, or with an adjective or noun plus a verb are mostly hyphenated. Their participles are also hyphenated wherever they are used. But their gerunds and other noun forms are separate unless definitely established otherwise.

to plane-polarize: a plane-polarizing method, plane-polarized light; plane polarization

to field-test: field-testing equipment, a field-tested round; field testing, a field test

to heat-treat: a heat-treating technique, a heat-treated tool; *but* heat-treating, heat-treatment

(c) Verb-adverb combinations, including combinations with prepositions used as adverbs, are not true compounds and are treated as normal phrasal verbs without hyphenation. Their participles are therefore hyphenated when used as unit modifiers before nouns, but not otherwise. Their gerunds remain separate. Note, however, that a number of corresponding adjectives and nouns, often with slightly different shades of meaning, are established as independent compounds, some with hyphens and some solid.

to break down: a broken-down part, a part that has broken down, *but* the breakdown voltage; the act of breaking down, *but* a breakdown

to cut off: a cutting-off action, a piece already cut off, *but* a cutoff point; the means of cutting off, *but* a cutoff

to feed back: fed-back energy, *but* a feed-back coil; the manner of feeding back, *but* the amount of feedback

to set up: set-up equipment, equipment that has been set up; the cost of setting up, *but* a good setup

to stand by: a stand-by generator; the reason for standing by, *but* the last stand-by

Numbers and Units of Measurement. It is sometimes difficult to distinguish combinations of numerals and units of measurement that are unit modifiers from those that are not. Yet only the unit modifiers take hyphens, thus:

a 2-ton truck
in 100-foot rolls
using a 2-mm-wide quartz ribbon (a 2-millimeter-wide quartz ribbon)
not less than a 3-inch inside diameter
reached a 250-mph IAS (a 250-mile-per-hour indicated air speed)

The following combinations are not unit modifiers, however, and consequently do not take hyphens. (Note that in a true unit modifier the unit of measurement is in the singular even with a value greater than one.)

a truck with a capacity of 2 tons
in rolls 100 feet long
using a quartz ribbon 2 mm wide (2 millimeters wide)
not less than 2 in. ID (2 inches inside diameter)
moving at 250 mph IAS (250 miles per hour indicated air speed)

The next three examples are also easy to confuse. Hyphens are required in the first and second because the percentages apply directly to the solution and the nitric acid, respectively. But hyphens would be wrong in the third because the method of expression is an idiomatic one in which the percentages apply to the system rather than to the nitric acid and the water, with "of" understood after "percent" in each instance.

a 5-percent solution of sodium carbonate
a small amount of 95-percent nitric acid
a system containing about 40 percent nitric acid and 60 percent water

Special Nomenclature. There are many types of special designations encountered in technical writing that may or may not include hyphens and word spacing in their patterns: trade names, official designations of rounds and components, parts numbers, the numbers identifying task assignments, the names of chemicals, and other well-systematized technical nomenclature. These are sufficiently identified as units by their characteristic patterns, hence should always appear the same way, irrespective of further compounding. Consult an authority in the specific field for the correct form and use it consistently.

For example, instructions from *Chemical Abstracts* state in part: It is considered good practice to limit the use of hyphens in organic names to the attachment of position numbers and symbols and the like, as 1-*sec*-butyl-2,4-diiodobenzene and α-amino-*m*-toluic acid. The prefixes "allo," "cyclo,"

"etio," "homo," "iso," "neo," and "pseudo" are joined in names without the use of hyphens and without italicizing.

Miscellaneous. Some other minor but troublesome points are these:

(a) When a compound noun that is normally solid or hyphenated is preceded by an adjective that modifies only the first part of the compound, separate the first part from the rest of the noun and join it to the adjective with a hyphen so as to insure the correct interpretation.

a new aircraft	*but*, a lighter-than-air craft
all taxpayers	*but*, all income-tax payers

(b) Written-out, two-word numbers below one hundred, also two-word fractions, are hyphenated whether used as nouns or adjectives; but adjustments are made in more complex combinations.

twenty-one	one hundred seventy-five
thirty-second	one hundred thousand
one-half	three ten-thousandths
three-quarters	twenty-eight thirty-seconds
one hundred	one two-hundredth

(c) Capitalization in title situations does not affect the hyphenation of compounds, nor does the use of all caps in headings or illustrations.

Tests With 5-Inch Rocket Motors
Typical Pressure-Time Curves
PLANE-POLARIZING CELL

(d) Designations of the following types, like multiple-word proper names, are not hyphenated as unit modifiers. Their unity is already unmistakable and the hyphen would be confusing.

the Mk 2 version of the round
with a Class A amplifier
a No. 30 drill
2-in. OD tubing (*not* 2-in.-OD tubing)

(e) The type of inversion that frequently takes place in listings does not affect the hyphenation of unit modifiers.

tubing, 2-inch, threaded both ends
motors: 3-phase, 60-cycle, 115-volt

(f) When two or more hyphenated compounds in close sequence have a common second element, you may omit the common element from all but the last; but be sure to retain the hyphens.

using 6- by 9-cm film
all 2.75- and 6.50-inch rockets
the 10-, 12-, and 14-cc samples
silk-, cotton-, or plastic-covered wire

ABBREVIATIONS

Introduction. Nowhere will you find a simple answer to the problem of abbreviations. Modern technical writing deals constantly with thought units so lengthy and involved when set forth in normal language that special devices must be used to prevent the reader from getting lost. Yet several of the major fields of science and technology have adopted systems of abbreviations, symbols, and signs that differ in many details and are not altogether compatible.

The large publishing houses have been forced to recognize this fact. For example, the Government Printing Office says:

> Some scientific, technical, and industrial groups have adopted definite forms of abbreviations for terms in their specialized fields, and these forms are acceptable for use in publications falling within the respective classes.
>
> —GPO, *Style Manual*, p. 93

Nevertheless, it is advisable here at NOTS, where many of these fields overlap, to standardize at least the less controversial details for the sake of efficiency and a degree of uniformity, while at the same time recognizing the forms preferred in the different fields whenever they have real significance.

The principal disagreements arise in connection with (a) the method of abbreviating compound units formed from simple units, (b) the selection of one of several acceptable abbreviations for a word or expression, and (c) capitalization and punctuation. Of these, the first is critical. In some fields it is convenient, or even mandatory because of mathematical considerations, to maintain the identity of the simple unit in the compound abbreviation. Then, for example, the preferred form of the abbreviation for "feet per second" is "ft/sec" (or the more formal equivalent, "ft per sec"), which keeps intact the "ft" and "sec" of the simple units. In other fields, the expanded form is needlessly cumbersome, hence the more compact "fps" is preferred. Both systems should therefore be permitted.

The other points of disagreement are less significant and can usually be accommodated by restricting abbreviations to forms that are recognized without hesitation and taking care that punctuation, capitalization, or the lack of them does not lead to confusion.

The List. With these considerations in mind, a list of standardized abbreviations has been compiled for your use in technical reports. This list, which follows the discussion, is in two parts. The first covers units of measurement; the second, other words and phrases with technical application, together with a few of the abbreviations common to all writing.

The division is made because abbreviations of units of measurement constitute a special category in modern technical writing and are so treated in the discussion. Symbols and signs are also treated separately, as are certain borderline types of abbreviations; but they are omitted from the list, since they are either so well standardized as to be no real problem (chemical and mathematical symbols) or so divergent from field to field that listing is impractical (letter symbols in general).

Definitions. Distinguish ordinary abbreviations from symbols and signs, both as to function and as to typography. The following definitions, which are generally recognized in practice, are useful for this purpose.

Abbreviations are shortened forms of words or expressions that normally consist of one or more letters taken from the words they represent (sometimes from the spelling in another language). They are most frequently read as the full expression. They are printed in the same type face as the text and are traditionally punctuated with periods to distinguish them from words.

Do not confuse them with contractions (sec'y) or with colloquial short forms (photo, exam). Also distinguish simple letters of the alphabet used to serialize a list of items, indicate subordination, identify parts of an illustration, represent points on a curve, designate a shape, or replace a proper name.

Letter symbols are single letters of the alphabet (and usually so read) that are used in mathematical and similar context to represent physical magnitudes. They are modified as necessary by the use of superscripts and subscripts, which may themselves consist of abbreviations, symbols, or signs. By extension, they are sometimes used to represent other types of concepts. They are generally chosen so as to suggest the concept they represent, but may be arbitrary.

They are typographically distinguished from abbreviations by the choice of a special alphabet, such as the Greek, or by a special kind of type, such as italic or boldface (shown by simple and wavy underscoring, respectively, in typewritten matter). When placed together without a sign,

they commonly represent a product. They do not take periods. For example:

$$L,\ \rho,\ P_{av},\ Q^{y+1},\ \pi R^2$$

Graphical symbols are conventionalized diagrams and letters used in drawings and illustrations for many purposes. Examples are the arrows used in dimensioning, the representations of electrical components in circuit diagrams, the marks indicating topographical features in maps, and the devices showing structural materials in architectural drawings.

Chemical symbols are letters, frequently in combination with other devices, that are used to represent the names of elements, radicals, and other groups in formulas, equations, and chemical context generally. They resemble abbreviations in that they consist basically of one or more letters of the English alphabet and are set in roman type; yet they are used as symbols in equations and formulas, although implying a structural relationship rather than multiplication when placed together. They never take periods. For example:

H, Mg, Me, Ac

Signs and operators are characters used primarily with letter symbols to express mathematical relations and operations. Some of them are arbitrary signs (+, −, >, =); some are letters from an alphabet, English or otherwise, but often in a rarely used form (d, ∂, Δ, Σ, $\int$); others are in fact abbreviations without periods (sin, csc, log, exp, Im).

Punctuation, Capitalization, and Form. For purposes of punctuation and capitalization, it is necessary not only to distinguish abbreviations from symbols and signs (see the definitions above) but also to differentiate the two main classes of abbreviations given in the list and to consider some borderline types.

Abbreviations of Units of Measurement. (1) Omit periods with abbreviations of this class except where confusion might result. They are instantly recognizable in technical writing because of their nature and immediate association with numerical values.

(2) In practice, the period is required only when the abbreviation spells a common English word and is not otherwise distinguished from that word by capitalization or compounding with other units. The simple "in." is the only frequently encountered exception: 62 lb/in^2, 175 in-lb; *but* 5-in. tube, and 10 in. in length.

(3) Do not capitalize such abbreviations in text, tables, figure legends, headings, and titles wherever the distinction between capitals and lower case is maintained (except, of course, to retain the intrinsic capitalization in those like Btu, °C, L, Mv). Use all capitals, however, wherever the typography is all capitals.

(4) Use the same form for the plural as for the singular.

(5) Leave a space before even a single-letter abbreviation following a numeral, but not between the numeral and the degree sign used with the abbreviation of a temperature scale.

75 ft 750 A 60°C

(6) The list includes most of the simple units and many of the compound units likely to occur in NOTS reports, but is not exhaustive. Variant forms are given only when there is a significant divergence from one *system* to another. The alternates for compound units involving the concept "per" are given in the compact form using the solidus (lb/in^2). The longer forms are equally correct and somewhat more formal (lb per sq ft) but tend to defeat the purpose of the abbreviation.

Other Abbreviations. (1) Retain periods with abbreviations other than units of measurement except when they are both adequately distinguished by typography or placement and in a form generally recognized without periods.

(2) The exceptions that do not take periods fall into three groups: (a) common abbreviations (av., max.) used as subscripts or superscripts to letter symbols, or otherwise used as mathematical abbreviations (P_{av}, T_{max}); (b) abbreviations in all capitals that are widely accepted when consistently used in this form (ID, OD, FM, IF, RF); and (c) a few others that are either invariably associated with a number or very specialized in use (2nd, 4th, Mk 2, jg, Pfc).

(3) In title situations and wherever principal or first words are given initial capitalization, capitalize the lower-case abbreviations of this class as you would the words they represent and retain the periods. However, within the boundaries of an illustration in which the convention of lettering in all capitals is being followed, use all capitals for such abbreviations and omit the periods.

(4) The list gives commonly used distinctive forms of abbreviations of this class, compiled from a number of authoritative sources. Inconsequential variations have been disregarded. Capitalized forms are shown only when they are known to be preferred for text use in some fields.

(5) Note that most abbreviations representing expressions of two or more words are spaced when composed of more than one letter from any word (at. wt.) but not spaced when composed of a single letter from each word (m.p.).

Initial Letters in Symbol Form. (1) This borderline group of abbreviations or symbols includes combinations of initial letters from the names of government agencies, other organizations, installations, pieces of equipment, points of the compass, and the like, that are in fact short forms of the names. They are pronounced as single letters or combinations of letters rather than as the words they represent. The names of certain projects may be considered in the same category, although expanded forms do not always exist; and the call letters of radio stations are similar in treatment, although not usually in derivation.

(2) For such combinations of letters, use all capitals without space or periods except where the use of lower-case letters is definitely established. For example: NOTS, NOL, CLPP, NW, KECA, NAVORD; *but* BuOrd, BuAer.

Mathematical Abbreviations. (1) The abbreviations used in mathematics to denote relationships and operations (sin, csc, log, exp, Im, *etc.*) are functionally related to signs and operators (see definition above). They do not take periods. They are always in roman type to distinguish them from letter symbols and are never capitalized except as capital letters occur in the abbreviations themselves.

(2) With the exception of the forms for *cosecant* and *cotangent*, these abbreviations appear to be standardized, hence are not included in the list. See any good handbook. Use "csc" and "cot" to avoid variation in your reports.

Chemical Symbols. Although in the form of abbreviations, chemical symbols are always roman and always the same capital letter or combination of capital and lower-case letters irrespective of context or otherwise all-caps typography. They never take periods. They are thoroughly standardized, hence excluded from the list.

Symbols and Signs. True symbols and signs are unmistakably distinguished from words by their typography, therefore never require the period of the normal abbreviation. A letter symbol is intrinsically a capital or lower-case character in a definite special alphabet or kind of type, and must therefore always remain the same irrespective of its location in titles or all-caps typography, or even at the beginning of a sentence (a location to be avoided, however, whenever feasible).

Choice. Whenever feasible, limit your choice of abbreviations to those given in the list. Where alternates are given, use the form that best suits your purpose or is most acceptable in your field; but keep all abbreviations of similar nature in parallel form. When it is necessary to use compound units of measurement beyond those given, follow the pattern of these examples unless it is definitely unsuitable: ft/sec^2; ft-lb/slug; Btu/(ft^2)(hr)(°F).

If you find it necessary to introduce different or additional technical abbreviations, make certain that they are accepted in your field; adapt them to the present system of capitalization and punctuation; and call attention to them in a note to the editor. For additional abbreviations common to all writing, see *Webster's*.

In many fields, letter symbols are at least partially standardized. See the Bibliography for some of the sources. Whether you choose these or other symbols, limit your choice whenever possible to the special characters available on the TPD's composing machines, a list of which is given on page 131.

When To Use. In general, use abbreviations only for good reason; that is, (a) to save a significant amount of space or avoid cumbersome repetition, (b) when the reader is more familiar with the abbreviation than with the full expression and would stumble over the full form, and (c) when the use of an abbreviation is conventional. Use letter symbols, graphical symbols, chemical symbols, and signs and operators wherever appropriate. But avoid all abbreviations and symbols that your reader will not recognize immediately, unless, of course, you define them on first use or in a nomenclature.

Since textual presentation is more formal than either tables or figures and space is much less of a consideration, abbreviations should normally be used more sparingly in text. Some working principles are the following.

In Text. (1) Spell out short and simple units of measurement (pounds, inches, seconds, volts, liters) unless the units are used so frequently that the abbreviations are of some real value. Abbreviate compound units and cumbersome simple units, however, when used with numerals (1,500 psi *or* lb/in^2, 725 ft-lb, 30 cc). Use few other abbreviations except those well established for text and those genuinely awkward to avoid in a given report because of the nature or frequency of the expressions they represent; for example: etc., i.e., p.m., Fig., OD, RF, a.c., m.p.

(2) Use the more formal versions of abbreviations of units of measurement if you prefer (lb per sq in., cu ft). But be consistent throughout the text, both as to the system and the exact form.

(3) In text footnotes, lists, definitions, and tabulations use abbreviations more freely.

In Tables. Abbreviate units of measurement as the normal practice in tabular matter, except for the very short words. To save space, use the compact forms of the abbreviations (ft^2, lb/in^2, [illegible]) rather than using the more formal [illegible] (as in text, sq ft, lb per sq in.); but use the same system—not "psi" in one place and "lb/in^2" in the other. Abbreviate other words whenever necessary to gain space.

In Figures. (1) Use abbreviations more freely in figures than in either text or tables. For suitable abbreviations beyond those given in the list, *see* JAN-STD-12, *Joint Army-Navy Standard Abbreviations for Use on Drawings.* For graphical symbols, see especially JAN-STD-1, *National Military Establishment Standard for General Drawing Practice,* and JAN-STD-15, *National Military Standard for Electrical and Electronic Symbols.* Other pertinent references are also listed in the Bibliography.

(2) For reasons of economy, TPD follows as a standard practice the drafting conventions of all-caps lettering and minimum punctuation for dimensions, callouts, labels of coordinates and curves, short notes, and all such brief matter within the boundaries of illustrations. In keeping with this style, abbreviations are likewise all caps and periods are normally omitted, even after abbreviations that otherwise spell common English words. Since few words are involved, the period is rarely needed to prevent confusion. Letter symbols, however, are always in the correct special alphabet or kind of type (Greek, italic, boldface, etc. capital or lower case). Whenever this style is acceptable, therefore, please conform to these conventions in the manuscript version of the illustration.

(3) In the rare instances when this standard is not suitable, as for example when critical differentiation between abbreviations would be lost, be sure to request specifically that text typography be used.

(4) On the other hand, follow text conventions for all extensive notes associated with illustrations. These will normally be set in text style either outside the boundary of the figure, usually as notes in the legend, or as a block within the figure.

Miscellaneous. There are some additional points that should be remembered in connection with abbreviations.

(1) When referring to figures, equations, and items in a bibliography or list of references, use the abbreviated forms Fig. 2, Eq. 3, Ref. 5 (with the same form of the abbreviation

for singular and plural) except at the beginning of a sentence in formal text. To indicate consecutive, inclusive numbers, use a hyphen (en dash in printing): Fig. 3-6, Eq. 4-7. Note that the open form of the equation number permits the use of simple parentheses when the reference itself is parenthetical.

(2) With simple series of numerical values and where ranges are expressed, give the unit of measurement only after the last: 900 and 1,200 psi; at 70-75°F.

(3) Designate components in electronic circuits by means of simple letter-number combinations wherever feasible, thus avoiding the typographical complexity of subscripts and dashes: C3, R27, T4, V5.

(4) In designations of ordnance equipment, "Mark" is spelled out only on the cover and title page of a report and in a letter of promulgation. Everywhere else use the abbreviation with the numeral: Mk 6.

(5) The style for abbreviations of journal titles in lists of references, bibliographies, and bibliographical footnotes is all capitals without periods. See Special Report 556-1, *Abbreviations of Periodical Titles for Use in NOTS Technical Reports* for the exact forms.

(6) Avoid the capital letter "M" as a prefix meaning "thousand" because of its now generally recognized meaning "million" (Mc, Mv). Likewise, avoid the lower-case "m" with the meaning "one millionth" to prevent confusion with its meaning "one thousandth" (mm, mw); use μ instead (μf, μw).

LIST OF ABBREVIATIONS

PART 1. UNITS OF MEASUREMENT

Use the same form for singular and plural abbreviations.

absolute ampere	abamp
acceleration due to gravity	*g*
acre	spell out
acre-foot	acre-ft
air horsepower	air hp
ampere	amp
ampere-hour	amp-hr
ampere-turn	a-t
angstrom	A
atmosphere	atm
barrel	bbl
billion electron volts	Bev
brake horsepower	bhp
brake horsepower-hour	bhp-hr
British thermal unit	Btu
caliber	spell out
calorie (small)	cal
Calorie (large)	Cal
candle	c
candle-hour	c-hr
candlepower	cp
candles per square meter	c/m^2
centimeter	cm
centimeters per second	cm/sec
centipoise	cp
circular mil(s)	cir mil(s)
coulomb	spell out
cubic centimeter	cc; cm^3
cubic foot	cu ft; ft^3
cubic feet per minute	cfm; ft^3/min
cubic feet per second	cfs; ft^3/sec
cubic inch	cu in.; in^3
cubic meter	cu m; m^3
cubic micron	cu μ; μ^3
cubic millimeter	cu mm; mm^3
cubic yard	cu yd; yd^3

cycle	spell out
cycles per second	cps
day	spell out
decibel	db
decibels of power referred to 1 milliwatt	dbm
degree (angular)	deg*
degree Baumé	°B
degree centigrade (Celsius)	°C
degree Fahrenheit	°F
degree Kelvin	°K
degree Réaumur	°R
dozen	doz
effective horsepower	ehp
electromagnetic unit	emu
electron volt	ev
electrostatic unit	esu
entropy unit	eu
erg	spell out
farad	f
fathom	fath
feet per minute	fpm; ft/min
feet per second	fps; ft/sec
foot	ft
foot, board measure	fbm
foot-candle	ft-c
foot-lambert	ft-L
foot-pound	ft-lb
friction horsepower	fhp
gallon	gal
gallons per minute	gpm; gal/min
gallons per second	gps; gal/sec
gram	g
gram-calorie	g-cal
henry	h
horsepower	hp
horsepower-hour	hp-hr
hour	hr
hundredweight	cwt
inch	in.
inches per second	ips; in/sec
inch-pound	in-lb
indicated horsepower	ihp
indicated horsepower-hour	ihp-hr
international angstrom	IA

* When minutes or minutes and seconds are included, use the form 90°20′34″.

joule	j
kilocalorie	kcal
kilocycles per second	kc
kilo electron volt	kev
kilogram	kg
kilograms per cubic meter	kg/m^3
kilograms per second	kgps; kg/sec
kilogram-calorie	kg-cal
kilogram-meter	kg-m
kilojoule	kj
kiloliter	kl
kilometer	km
kilovar	kvar
kilovolt	kv
kilovolt-ampere	kva; kv-amp
kilovolts peak	kvp
kilowatt	kw
kilowatt-hour	kwhr; kw-hr
knot	spell out
lambert	L
liter	l
lumen	l; lu
lumens per watt	lpw; lu/w
lumen-hour	l-hr; lu-hr
mean horizontal candlepower	mhcp
megacycles per second	Mc
megawatt	Mw
megohm	MΩ; meg
meter	m
meter-kilogram	m-kg
mho	spell out
microampere	μa
microangstrom	μA
microfarad	μf
microgram	μg; γ
microhenry	μh
microinch	μin
micromicrofarad	μμf
micromicron	μμ
micromole	μM
micron	μ
microsecond	μsec
microvolt	μv
microwatt	μw
mil	spell out
mile	mi
miles per hour	mph; mi/hr

milliampere	ma
milliangstrom	mA
millicurie	mC
millicycles per second	mc
millifarad	mf
milligram	mg
millihenry	mh
millilambert	mL
milliliter	ml
millimeter	mm
millimicron	mμ
millimole	mM
million electron volts	Mev
million gallons per day	mgd
million volts	Mv
millisecond	ms
millivolt	mv
milliwatt	mw
minute (angular)	min*
minute (time)	min
mole	spell out
month	mo
ohm	Ω
ounce	oz
ounce-ft	oz-ft
ounce-inch	oz-in
parts per million	ppm
pint	pt
pound	lb
pounds per cubic foot	lb/ft^3
pounds per square foot	psf; lb/ft^2
pounds per square inch	psi; lb/in^2
pounds per square inch absolute	psia; lb/in^2 abs
pounds per square inch gage	psig; lb/in^2 ga
pound-foot	lb-ft
pound-inch	lb-in
quart	qt
radian	rad
reactive kilovolt-ampere	kvar
reactive volt-ampere	var
revolution	rev
revolutions per minute	rpm; rev/min
revolutions per second	rps; rev/sec
rod	spell out
roentgen	r

* When degrees or degrees and seconds are included, use the form 90°20'34".

second (angular)	sec*
second (time)	sec
shaft horsepower	shp
slug	spell out
spherical candlepower	scp
square centimeter	sq cm; cm^2
square foot	sq ft; ft^2
square inch	sq in.; in^2
square kilometer	sq km; km^2
square meter	sq m; m^2
square micron	sq μ; μ^2
square mile	sq mi
square millimeter	sq mm; mm^2
square yard	sq yd
thousand foot-pounds	kip-ft
thousand pounds	kip
ton	spell out
volt	v
volt-ampere	va
volt-ampere reactive	var
watt	w
watts per candle	wpc
watt-hour	whr
week	wk
yard	yd
year	yr

PART 2. OTHER ABBREVIATIONS

about	abt.
absolute	abs.
abstract	abstr.
addition	addn.
additional	addnl.
alcohol, alcoholic	alc.
alkaline	alk.
alkalinity	alky.
alternating current	a.c.; AC
altitude	alt.
amalgam, amalgamated	amal.
amorphous	amorph.
amount	amt.
amplitude modulation	AM
anhydrous	anhyd.
answer	ans.

* When degrees or degrees and minutes are included, use the form 90°20′34″.

ante meridiem (L., before noon)	a.m.
apparatus	app.
approximate, approximately	approx.
aqueous	aq.
associate(s)	assoc.
associated	assocd.
association	assocn.
atomic	at.
atomic number	at. no.
atomic weight	at. wt.
audio frequency	a.f.; AF
auxiliary	aux.
avenue	ave.
average	av.
avoirdupois	avoir.
azimuth	az.
barometer	bar.
Baumé	Bé.; B
board	bd.
boiling point	b.p.
boulevard	blvd.
calculate	calc.
calculated	calcd.
calculating	calcg.
calculation	calcn.
center line	c.l.; CL
center of gravity	c.g.; CG
center of impact	CI
center of pressure	c.p.; CP
center to center	c. to c.
centigrade	C
centimeter-gram-second (system)	c.g.s.
chemical; chemist; chemistry	chem.
chemically pure	c.p.
chord	cd.
circa (about)	ca.
circular	cir.
circumference	circum.
coefficient	coef.
commercial	com.
composition	compn.
compound; compounded	compd.
concentrate	conc.
concentrated	concd., conc.
concentrating	concg.
concentration	concn.
conductivity	cond.

confer (L., compare)	cf.
constant	const.
containing	contg.
continued	contd.
continuous wave	c.w.; CW
corrected	cor.
cost, insurance, and freight	c.i.f.
counter electromotive force	c.e.m.f.; CEMF
critical	crit.
crystalline	cryst.
crystallization	crystn.
crystallized	crystd.
crystallizing	crystg.
current density	c.d.
cylinder; cylindrical	cyl.
dark	dk.
decompose (s)	decomp.
decomposed	decompd.
decomposing	decompg.
decomposition	decompn.
definition(s)	def.
derivative	deriv.
determine	det.
determined	detd.
determining	detg.
determination	detn.
diameter	diam.; D
dilute	dil.
diluted	dild.
dilution	diln.
direct current	d.c.; DC
dissociate(s)	dissoc.
dissociated	dissocd.
dissociation	dissocn.
distilled	distd.
distilling	distg.
distillation	distn.
ditto	do.
double-pole (switch)	DP
double-pole double-throw (switch)	DPDT
double-pole single-throw (switch)	DPST
edited; edition	ed.
editor(s)	ed(s).
electric, -al	elec.
electromotive force	e.m.f.; EMF
elevation	el.
equation(s)	eq.
equilibrium(s)	equil.

equivalent	equiv.
estimate	est.
estimated	estd.
estimating	estg.
estimation	estn.
et alibi; et alii (L., and elsewhere; and others)	et al.
et cetera	etc.
evaporate	evap.
evaporated	evapd.
evaporating	evapg.
evaporation	evapn.
examined	examd.
examining	examg.
examination	examn.
exempli gratia (L., for example)	e.g.
experiment	expt.
experimental	exptl.
explodes	exp.
external, -ly	ext.
extract	ext.
extracted	extd.
extraction	extn.
4-pole (switch)	4P
4-pole double-throw (switch)	4PDT
4-pole single-throw (switch)	4PST
feathery	feath.
figure(s)	fig.
fluorescent	fluores.
fluid	fl.
following (pages)	ff.
foot-pound-second (system)	f.p.s.
free on board	f.o.b.
freezing point	f.p.
frequency modulation	FM
fusion point	fn. p.
gage	ga.
gelatinous	gel.
geological	geol.
glacial	glac.
glycerin	glyc.
grain	spell out
greatest common divisor	g.c.d.; GCD
greatest common factor	g.c.f.; GCF
ground	gnd.
height	ht.
hexagon, -al	hex.
high explosive	HE

high frequency	h.f.; HF
high-pressure (adj.)	h.p.; HP
hydrogen ion concentration	*p*H
hygroscopic	hyg.
ibidem (L., in the same place)	ibid.
id est (L., that is)	i.e.
ignites; ignition	ign.
inclusive	incl.
indicated air speed	IAS
inside diameter	i.d.; ID
intermediate frequency	i.f.; IF
intermediate-pressure (adj.)	i.p.; IP
interrupted continuous wave	i.c.w.; ICW
isometric	isom.
isothermal	isoth.
isotropic	iso.
laboratory	lab.
latitude	lat.
leaflets	leaf.
least common multiple	l.c.m.; LCM
length	lgth.
limit	lim.
linear	lin.
liquid	liq.
loco citato (L., in the place cited)	loc. cit.
longitude	long.
low frequency	l.f.; LF
low-pressure (adj.)	l.p.; LP
magnetomotive force	m.m.f.; MMF
manufacturing	mfg.
mark	mk
mathematical; mathematics	math.
maximum	max.
mean effective pressure	m.e.p.
mechanical	mech.
medium	med.
medium frequency	m.f.; MF
melting point	m.p.
minimum	min.
mixture	mixt.
molar (as applied to concentration)	*M*
molecular weight	mol. wt.
molecule	mol.
monoclinic	monocl.
National Electrical Code	NEC
needles	need.
negative	neg.

nitrocellulose	NC
nitroglycerin	NG
normal	norm.
normal (as applied to concentration)	*N*
number	no.
observed	obs.
octahedral	octahdr.
opere citato (L., in the work cited)	op. cit.
organic	org.
orthorhombic	rhomb.
outside diameter	o.d.; OD
page	p.
pages	pp.
paragraph	par.
pathological	pathol.
perpendicular	perp.
physical	phys.
physiological	physiol.
plates	pl.
point	pt.
positive	pos.
post meridiem (L., after noon)	p.m.
potential difference	p.d.; PD
powdered	powd.
power amplifier	PA
power factor	p.f.
precipitate	ppt.
precipitated	pptd.
precipitating	pptg.
precipitation	pptn.
prepare	prep.
prepared	prepd.
preparing	prepg.
preparation	prepn.
pressure-volume-temperature	PVT
prisms	pr.
quadrant elevation	QE
qualitative	qual.
quantitative	quant.
quod vide (L., which see)	q.v.
radio frequency	r.f.; RF
radius	rad.; R
reference(s)	ref.
regular	reg.
relative humidity	RH
respectively	resp.

rhombic; orthorhombic ..... rhomb.
rhombohedral ..... rhbdr.
root-mean-square ..... r.m.s.; RMS

saponification ..... sapon.
saponified ..... sapond.
saponifying ..... sapong.
saturate ..... sat.
saturated ..... satd.
saturating ..... satg.
saturation ..... satn.
separate ..... sep.
separated ..... sepd.
separating ..... sepg.
separation ..... sepn.
single-pole (switch) ..... SP
single-pole double-throw (switch) ..... SPDT
single-pole single-throw (switch) ..... SPST
slightly ..... sl.
small ..... sm.
soluble ..... sol.
solution ..... soln.
specific gravity ..... sp. gr.
specific heat ..... sp. ht.
specific volume ..... sp. vol.
square ..... sq.
standard ..... std.
standing-wave-ratio ..... SWR
street ..... st.
switch ..... sw.; SW
symmetrical ..... sym.

tablets ..... tabl.
technical ..... tech.
temperature ..... temp.
tensile strength ..... t.s.
tetragonal ..... tetr.
translated; translation; translator ..... tr.
triclinic ..... tricl.
trigonal ..... trig.
trinitrotoluene ..... TNT
triple-pole (switch) 3P
triple-pole double-throw (switch) 3PDT
triple-pole single-throw (switch) 3PST

ultra-high frequency ..... u.h.f.; UHF

versus ..... vs.
vertical ..... vert.
very high frequency ..... v.h.f.; VHF
very low frequency ..... v.l.f.; VLF

videlicet (i.e., namely)	viz.
viscous	visc.
volume(s)	vol(s).
weight	wt.

APPENDIX

MATHEMATICAL SYMBOLS

From the compositor's point of view, mathematical treatments are becoming more and more complicated, which means that setting them up on the Vari-typer is becoming more and more expensive in terms of man-hours and money. A great deal of the complexity is inherent in the subject matter and cannot be avoided; consequently, every effort should be made to eliminate those complexities that are merely matters of personal preference and have no real mathematical significance. The rewards for such effort are lower costs and earlier publication.

The special symbols shown here are those available in TPD in addition to the basic roman and italic alphabets. The list includes a variety of symbols that should suffice in most situations. You are urged to confine your choice to those that are available, for the introduction of symbols not in the list will force the compositors to resort to time-consuming hand work, which will delay the publication of your report unnecessarily. Before you begin the preparation of a manuscript, it would be advisable to check your symbols against this list and, if you are contemplating the use of symbols not shown, to substitute from the list wherever you can. If you find that you are faced with special problems that will require unusual treatment, it will be advisable to visit the Editorial Branch of TPD and get assistance in finding a solution. It is frequently possible to work out a satisfactory arrangement, if an editor has an opportunity to consider the problem before a large amount of material has been prepared.

Also included in this appendix is a list of mathematical equivalents, with the preferred forms shown at the left of the list. For typographical reasons these preferred forms make for speed and economy in setting up the material. They should be used wherever feasible.

SPECIAL SYMBOLS AVAILABLE

1. Italic (entire cap alphabet):

$\overline{A}\ \overline{B}\ C\ D\ E\ F\ G\ H\ I\ J\ K\ \overline{L}\ \overline{M}\ \overline{N}\ \overline{O}\ \overline{P}\ \overline{Q}\ \overline{R}\ \overline{S}\ \overline{T}\ \overline{U}$

$\overline{V}\ \overline{W}\ X\ Y\ Z$

2. Italic lower case. Only the following are available:

$\bar{i}$ $\bar{b}$ $\bar{d}$ $\bar{l}$ $\bar{f}$ $\bar{b}$ $\bar{k}$

3. Roman (entire cap alphabet):

$\bar{A}$ $\bar{B}$ $\bar{C}$ $\bar{D}$ $\bar{E}$ $\bar{F}$ $\bar{G}$ $\bar{H}$ $\bar{I}$ $\bar{J}$ $\bar{K}$ $\bar{L}$ $\bar{M}$ $\bar{N}$ $\bar{O}$ $\bar{P}$ $\bar{Q}$ $\bar{R}$ $\bar{S}$ $\bar{T}$ $\bar{U}$

$\bar{V}$ $\bar{W}$ $\bar{X}$ $\bar{Y}$ $\bar{Z}$

4. Roman lower case. Only the following are available:

$\bar{t}$ $\bar{h}$ $\bar{d}$ $\bar{l}$ $\bar{f}$ $\bar{b}$ $\bar{k}$

5. Only the following Greek with bars are available:

$\bar{\Gamma}$ $\bar{\Upsilon}$ $\bar{\Pi}$ $\bar{\Sigma}$ $\bar{\Theta}$ $\bar{\Xi}$ $\bar{\Psi}$ $\bar{\Omega}$ $\bar{\beta}$ $\bar{\delta}$ $\bar{\xi}$ $\bar{\zeta}$

$\bar{\psi}$ $\bar{\vartheta}$ $\bar{\Delta}$ $\bar{\phi}$ $\bar{\Lambda}$ $\bar{\lambda}$ $\bar{\theta}$ $\bar{\Phi}$

6. Single prime (entire roman, italic, and Greek alphabets):

a′ *b′* *c′*, *A′* *B′* *C′*
a′ b′ c′, A′ B′ C′
γ′ δ′ θ′, Γ′ Δ′ Θ′

7. Double prime (entire roman, italic, and Greek alphabets):

a″ *b″* *c″*, *A″* *B″* *C″*
a″ b″ c″, A″ B″ C″
γ″ δ″ θ″, Γ″ Δ″ Θ″

8. Greek alphabet (upper and lower case):

γ δ θ, Γ Δ Θ

9. Boldface Lambrakis Greek alphabet. Only the following are available:

ω ϑ α Δ υ ν κ Ω β χ δ λ Σ μ ο ε ς ρ π φ θ γ ζ Ξ η ι τ

10. Demibold Futura (entire upper and lower case alphabets):

a b c d e f g h i j k l m n o p q r s t
u v w x y z
A B C D E F G H I J K L M N O P Q R S T
U V W X Y Z

Special matrices carry the following dotted characters only:

ȧ *ä* *ė* *ë* *ġ* *ï* *ṁ* *ṅ* *ṙ* *ẗ* *q̇* *ü* *ẋ* *ẍ* *ż*

ȧ ä ė ë ġ ï ṁ ṅ ṙ ẗ q̇ ü ẋ ẍ ż

Special Greek matrices carry the following dotted characters in 10-point only:

η̇ *β̈* *γ̇* *θ̈* *ÿ* *ξ̈* *θ̇* *ë* *δ̈* *η̈* *φ̇* *ω̈* *ζ̈* *ψ̇* *ψ̈*

Special German characters are available in the following characters only:

𝔲 𝔖 𝔐 𝔘 𝔖 𝔐

PREFERRED FORMS

For typographical reasons the following are preferred:

$\exp(x^2 - y^2)$ instead of $e^{x^2-y^2}$

$(1 - AB)^{1/2}$ instead of $\sqrt{1 - AB}$

D^{-1} instead of $\frac{1}{D}$

$B\mathcal{G}$ instead of $B\hat{G}$

GLOSSARY

backed up. Printed on the reverse side of a sheet, the front of which has already been printed.

callout. The designation on an illustration of a curve, piece of machinery, or any other item by text, letters, numbers, or symbols.

caps. Capital letters; also called *upper case*. *All caps* in manuscript means that all the matter so marked is to be set in capital letters.

compose. To set type and to arrange it in suitable form for printing. A *compositor* is one who sets and arranges type; *composition* denotes the act of setting and arranging type.

copy. All material transmitted to the publisher to be used in the production of printed matter. It may consist of manuscript, printed material, illustrations, photographs for reproduction, etc.

crop. To trim off a portion of foreground, background, or sides of an illustration to secure desired proportions or to remove nonessential details.

display. To set off headings, quoted material, etc., by using type of size or style distinct from that used in text; to set off text matter by indentions and spacing.

edition. The first printing of a book, or any subsequent one that is different from a previous printing. Subsequent printings without change are designated as *impressions*.

flush. With no indention. *Flush left*, set at the left margin; *flush right*, set at the right margin.

foldout. An oversize page used in printing large illustrations or tables.

format. The general style of a publication with respect to size and style of type, size of page, margins, etc.

frontispiece. An illustrative or ornamental figure that faces the title page. To be used only to illustrate the title of a report requiring special typographic treatment.

half title. The title of a book placed on the right-hand page immediately preceding the full title page when a frontispiece is used; a title, as of a part or chapter, standing alone on a page introducing the part or chapter.

halftone. Picture in which the gradation of tone is reproduced by a graduation of dots, produced by the interposition of a screen during exposure.

headnote. A note set between the title and body of a table, used to supply information, qualifications, and values that apply to the table as a whole.

layout. A working diagram of a book which is to be composed, usually specifying the sizes and kinds of type to be used.

leaders. Periods used to lead the eye from one item to another item on the same line.

manuscript. An author's copy whether handwritten or typewritten.

MS. Abbreviation for *manuscript;* plural, MSS. (The period is retained.)

offset printing. Printing from zinc or aluminum plates on a press which first transfers the ink impression from the printing plate to a rubber cylinder, and then from the cylinder to the paper.

overlay. A protective sheet of transparent vellum used on all photographs and some manuscript copies of line drawings to carry callouts and instructions.

preliminary matter. All matter that precedes page 1 in a book. It consists of title page, foreword, abstract, contents, etc. Lower-case Roman numerals are used for folios of preliminary matter. Also is called *front* matter.

reference indexes. The superior numerals and letters (occasionally conventional symbols) used in text or tables to indicate reference to a footnote at the bottom of a page or below a table.

repro. Composed pages of a report prepared for offset reproduction.

retouching. Art work or painting done upon a photographic print to cover defects, correct tone values, eliminate parts not wanted, or put in additional parts.

text. The body of a book omitting preliminary matter, formal tables, illustrations, appendixes, etc.

type face. The face of a type, especially with reference to its shape, form, model, or character.

type font. An assortment of type of one size and style, including a due proportion of all the letters of the alphabet, large and small, points, accents, figures, etc.

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